THE EFFECT OF EDGE PREPARATION ON COATING LIFE PHASE ONE

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FOREWORD

This project constitutes a part of the National Shipbuilding Research Program (NSRP), which is cost shared between the U.S. Maritime Administration and the U.S. Shipbuilding Industry. This research project entitled "The Effect of Edge Preparation on Coating Life" was carried out by Franklin Research Center, Philadelphia, PA 19103 under a subcontract to Avondale Shipyards, Inc., New Orleans, LA 70150.

The principal objective of the NSRP is to improve productivity and reduce shipbuilding costs in order to meet the lower Construction Differential Subsidy rate goals of the Merchant Marine Act of 1970.

The project outline approved by the Society of Naval Architects and Marine Engineers' (SNAME) Ship Production Committee was followed closely during the course of this study.

Dr. Leslie W. Sandor, Manager of Materials Technology, Franklin Research Center, acted as Project Manager and Principal Investigator for this project. Mr. John W. Peart, R & D Program Manager, Avondale Shipyards, Inc. was responsible for the program's technical direction and publication of the report. Program definition and guidance were also provided by the members of SNAME Task Group #023-1 on Surface Preparation Coatings, Mr. C. J. Starkenburg, Chairman, Avondale Shipyards, Inc.

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EXECUTIVE SUMMARY

Presently, there is not a standardized method in the U.S. Shipbuilding industry of preventing premature coating failures along sharp edges and at surface discontinuities in flats. Such coating failures can lead to product contamination and high repair costs.

The general approach taken to solve these problems usually involves any one and/or combinations of the following procedures:

a) Sharp edges:

- o brushing, and/or striping or double spray coating,
- o reblasting,
- o grinding,

b) Surface discontinuities:

- o filling with compounds,
- o welding and grinding,
- o sectional cut-out.

A lack of standardization and definition of what requires special preparation and/or repair have of course created a considerable amount of misunderstanding among the parties involved. Faced with similar dilema, several shipbuilding nations have very recently issued standards or guideline documents for sharp edges and/or defective flat surfaces. The countries are Japan, Sweden, France, Italy and West-Germany. Copies of such documents obtained during Phase I of this project can be found in the Annex to this report.

It is recommended that a detailed test program, as Phase II, be started to quantity the effects of radius of curvature and/or bevel angle on the performance of the different marine coating systems in use today. It is believed that the results of Phases I and II will allow and set the stage for the development of a practical edge and surface preparation guideline document.

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(d) Swedish Standards:

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VIS 673 - Steel surface preparation before painting

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TANK COATING SPECIFICATIONS FOR PRODUCT CARRIERS
QUALITY AND INSPECTION STANDARD OF DE-RUSTING

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1. CONCLUSION

While the open literature was sparse in papers pertinent to the subject of this project, there were a few international publications addressing the very issue of sharp edges and defective flat surfaces.

The prerequisites of a good quality tank coating job include

- o proper surface preparation (blasting to “white metal”),
- 0 removal of dust, spent abrasives and finger prints,
- 0 smooth and continuous welds,
- 0 absence of weld spatter,
- 0 rounding off sharp edges,
- 0 elimination of significant defects in flats,
- 0 selection of an appropriate coating system:
  - (a) obtaining “resistance list” from the paint manufacturer,
  - (b) adequate number of coats of paint: sufficient film thickness without holidays,
- 0 proper application method:
  - (a) correct curing temperature,
  - (b) control of humidity,
  - (c) elimination of contaminants,
- 0 avoidance of touch-up and repair,
- 0 enforcement of good quality control procedures.

The type and rate of corrosion in tanks depend on

- o location,
  - above the liquid level
  - liquid-vapor interface
    immersed area
  - tank bottom
- o type of product carried,
- o impurities present,
- o amount of oxygen and/or water present,
- o temperature.

Initiation of corrosion occurs along sharp cages and at surface and structural discontinuities.

The performance of a given coating system on edges is effected by

- o cage radius,
- o surface preparation,
- o coating thickness and integrity,
- o viscosity,
- o environmental (exposure) conditions.

According to Kharlamov, ([5]) et al, an edge radius of about 5 mm (0.2 in) or a bevel angle of at least 150° is needed to equal the coating performance of flat surfaces.

The most common method of preparing edges and defective flats is grinding. Deeper surface defects are repaired by welding and subsequent grinding flush with the surface.

The extent of repair, inspection methodology and post weld repair heat treatments are described in a new document issued by IACS (International Association of Classification Societies).

There are a number of overseas countries - such as Japan, Sweden, France, Italy and West-Germany - that now have edge and surface preparation standards, or guideline documents.

II. PLAN OF ACTION

II.1 Objective

This project has as its prime objective to address the problems associated with sharp edges and surface defects on flats, both representing one of the most expensive coatings problems in terms of early coating failure, potential tank product damage and repair costs.

II.2 Introduction and Background

The state-of-the-art in the application of protective coatings for ships in general is of a subjective nature to a large extent. It follows that specifications vary and depend on paint manufacturer's recommendations, and/or the various requirements imposed by owner/operators and classification society guidelines. These various requirements and/or guidelines are in some ways so formulated as to try to suite the needs of a given cargo and/or product type carried. Notwithstanding, structural corrosion, cargo contamination and coating systems problems do exist.

Up until now, there has not been a generally accepted agreement on what might be the most cost-effective method for tackling these problems. Characteristically, the approaches taken to the one and the same problem varied according to the accepted practices of a given yard and/or its agreement reached with the owner/operator and the paint manufacturer. When faced with the problem in the climate of lacking industry or national or international standards on edge and surface preparations, the practice usually involved one or combinations of the following measures;

(a) On sharp edges:
- brush coating or striping,
- double spray coating.

(b) On flats:
- blasting with select abrasives,
- filling with compounds of one kind or another,
- grinding or chipping,
- welding,
- splicing or renewal with insert,
- doing nothing special.

None of these measures have been given a comprehensive engineering scrutiny. For example, it is still unknown, what the radius of curvature ought to be to yield equivalent coating Performance to that of a flat surface. The net result of all this is that the cost of satisfactory protection of edges and defective flats is unpredictable.

Edge and surface preparation standards that are practical and generally acceptable should indeed be beneficial to all concerned. To work towards that goal, an extensive literature and national as well as international shipbuilding industry survey was undertaken in Phase I of this project. The second phase will focus on testing and recommending standards according to the findings of Phase 1. This report seals with the results obtained in the first phase.

11.3 Procedure

A comprehensive literature survey was conducted with emphasis on project-related subject matter available in the open literature. First the abstracts of the selected articles were evaluated for relevancy. If appropriate, then the full texts were obtained for subsequent analysis. In case of foreign language papers, the publications were translated into English.

An industry survey was also carried out through two separate questionnaires which were mailed out to over 100 recipients worldwide. The recipients included shipbuilders, owner/operators, marine paint manufacturers and classification societies.

111. DISCUSSION OF RESULTS

A) Literature Survey:

A.l. Overview

In general, the problem areas on ships characteristically include the bottoms, boottoppings, decks and tanks. [1] For each of these areas, a certain generic coating system has evolved and most often used on commercial ships: Coal tar epoxy for bottom, ethyl silicate inorganic zincs and chlorinated rubber for the free boards, inorganic zinc and epoxies for decks and ballast tanks and specialized inorganic zinc for cargo tanks.

A good quality coating job requires [2]

- rounding of sharp edges,
- removal of significant defects from weld surfaces,
- elimination of weld spatter and other significant defects from flats,
- proper surface preparation,
- selection of appropriate coating systems for ship type, area and environment (exposure) under consideration,
- establishing list of items of coating resistance to cargo,
- proper application method and its control,
- ease of application,
- control of humidity,
- proper curing temperature,
- elimination of contaminants,
- adequate number of coats of paint,
- sufficient film thickness without holidays,
- avoidance of touch-up and repair of coatings,
- preventing scaffolds from damaging the tank coating,
- enforcing good quality control procedure,
- sufficient inspection.

Tank linings have two functions to fulfill; one to prevent product contamination, the other to protect the tank itself from corrosion. [3]

A well fabricated tank has a number of attributes from a coatings point of view, namely,

- all welds smooth and continuous,
- no sharp edges,
- no weld spatter,
- all surfaces blasted to near white metal,
- no dust or spent abrasive,
- no finger prints,
- coating prior to flash rusting,

The three most important aspects of tank protection include the selection of the coating system, surface preparation and application method. The selection

of the proper coating system requires that consideration be given to the type of product carried in a tank, the operating temperature and the extent and type of abrasion and/or impact as well as thermal shock. Good surface preparation consists of removing water soluble materials (sodium chloride and ferrous salts), oily residues, grease, rust and pits. ([4]) To help adhesion of the paint, the surface should have a proper anchor pattern obtained through abrasive blasting.

Application method is important for several reasons. A number of factors that can significantly influence the performance of the coating are application-related. These are porosity, film thickness, entrapment of solvents, dry spraying, thinners, air circulation, presence of contaminants, temperature and humidity control, application method, curing time and overspray.

Control of the environmental parameters is important both during surface preparation and application of the paint system. Humidity influences staining and rusting of the cleaned surface as well as the curing of the coating. Temperature of the steel has an effect on curing. Contaminants in the surrounding air and on the steel surface will bear heavily on subsequent paint performance and corrosion of the underlying metal.

A.2. Problems

A major problem in operating tankers in clean service is the corrosion of steel in the tanks. Corrosion of the cargo tank is caused by condensation of moisture and sulfuric acid. Segregate and seawater ballast tanks are frequently cleaned between cargoes. The rate of corrosion on the steel under these conditions is rapida with an eventual replacement of plate in order to meet classification requirements for hull strength.

There are different areas of contact with the stored product in tank linings. [(3)] Both the type and the rate of corrosion maybe different in the different areas. On this basis, tanks are divided into four areas, namely,

(1) vapor phase (above the liquid level),
(2) inter phase (liquid-vapor interphase),
(3) liquid phase (immersed area),
(4) tank bottom (settlement of heavy contaminants and moisture).

The rate of attack in these four areas is dependent on

(a) type of product carried,
(b) impurities present,
(c) amount of oxygen present,
(d) amount of water present,
(e) temperature.

The various chemical reactions lead to coating failures of the following types,

- 0 blistering,
- o rusting of the substrate,
- o softening,
- o cracking,
- o hardening,
- o peeling,
- o staining,
- o undercutting,
- o dissolution,
- o disintegration.

In general, corrosion will first occur where the protective system is the least effective such as along sharp edges and at surface as well as structural discontinuities.

A.2.1 Sharp Edges

According to the replies to the questionnaire, the most widely accepted quantitative definition of a sharp edge is when the radius of curvature is equal or less than 1 mm (0.04 in). Qualitatively viewed, edges are considered sharp when there are protuberances and the edge profile is jagged or uneven, as stated by several respondents.

The coating performance on edges has been found to be a function

1. edge radii,
2. surface preparation,
3. coating type,
4. film thickness.
5. film integrity,
6. paint viscosity,
7. environment type,
8. ambient temperature.

According to available literature, studies on the effect of edge preparation on coating life were done in the Soviet Union, Sweden and Italy. The most

comprehensive studies were those carried out by Russian researchers Kharlamov and Koshin.[5] Their results showed that for bevel angles <90°, effective edge protection cannot be obtained. The value of this critical angle may be slightly altered by the viscosity of the paint. As the bevel angle increases above 90°, edge protection increases with increasing film thickness for a given paint system, all else being constant.

The surface tension pulls the paint away from sharp edges. With bevel angle less than 150° [or less than 5 mm (0.2 in)] and with film thickness in the range of 100-15(11.1, (4-6 roils) complete edge protection relative to flats was still not possible.

The edge surface preparation methodology was unimportant in that it did not affect the life of the protective coatings, when the bevel angle was less than 135°. However, the surface preparation methodologies on beveled edges became significant at level angles greater than 150°. The edge preparation methods investigated included

wire brushing,
- etching,
- sandblasting and
- phosphatizing.

In general, coating life on bevel angle >=135° increased significantly. In terms of coating performance, a bevel angle of 150° corresponds to an edge radius of about 5 mm (0.2 in). So, from the Russian work it appears that for a given surface preparation and film thickness the plot of performance life versus bevel angle should show two significant rate changes schematically shown in Fig. 1.; one between 90-135°, the other above 135° and asymptotically approaching some maximum value of life. The maximum life which would equal the performance of flats would coincide with a bevel angle of >= 150° or about 5 mm (0.2 in) of edge radius. Life below 90° is very short. The types of test samples (of low-carbon steel) used by Kharlamov, et al, are illustrated in Fig. 2.

The actual bevel angles of 90°, 135° and 150° as well as the radii of curvature of 3 mm (0.12 in), and 5 mm (0.2 in) drawn to scale are exhibited in Fig. 3.

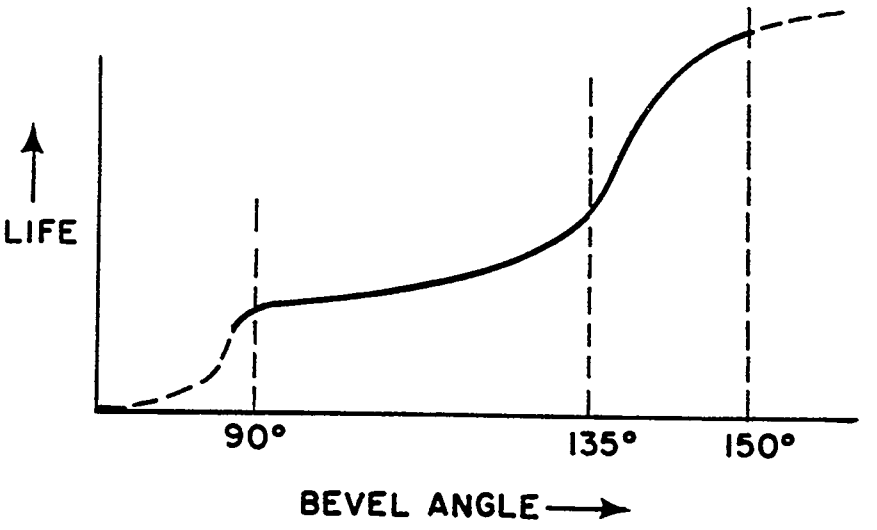


Fig. 1. A parametric graph of coating performance against bevel angle.

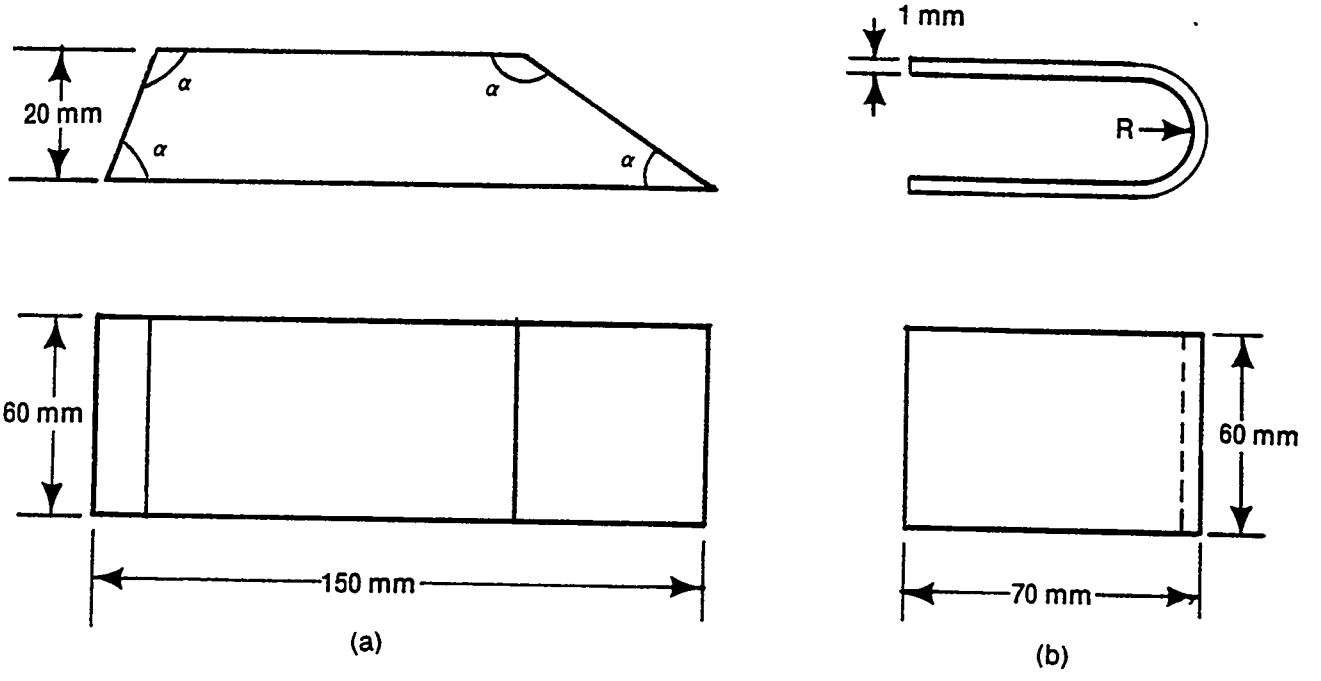
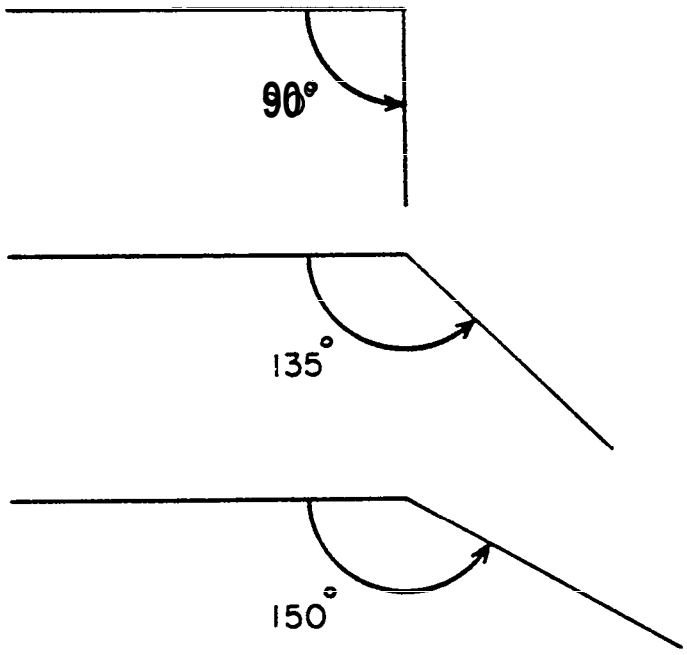


Fig. 2. Types of Test Samples used (Low-carbon steel).

where, α = bevel angle
R = radius of curvature

Actual bevel angles (α):



Actual radii of curvature (r):

3mm (0.12 in)-135°

5mm (0.2 in)- 150°

I

r

Fig. 3. Illustration of actual level angles and radii of curvature corresponding to significant changes in coating performance on edges.

Of the various surface preparation methods, wire brushing is the worst, because coating failure occurs virtually all over the surface simultaneously. This - according to Karlamov and Koshin - may explain the long-held philosophy that edge preparation was not important, since all structural surfaces were cleaned by wire brushing. With improved surface preparation techniques, edge protection becomes very important indeed. This is pursuant with today's coating practice and observations, namely that coating life is markedly affected by the degree of cleanliness achieved by the surface preparation method.

A Swedish paper written by Igetoft and Lingman is a condensation of literature search and some test results of their own.[6] According to this Study the coating thickness varied along the length of sharp edges even under laboratory conditions. So, under shipyard conditions the variation is expected to be much greater. Striping of sharp edges by brushing did not significantly increase the coating thickness. The effective edge radius giving the same coating thickness as flat surfaces is dependent on coating system type, more specifically on the paint viscosity. Rounding off sharp cages from 1 mm to 2.9 mm (~ 1/8") resulted in an increase in coating thickness and life. According to Igetoft and Lingman, rusting and/or coating failure depends on

- o type of coating system used,
- o environmental conditions, and
- o film thickness.

They claim that "corrosion often but not always begins at edges. There is no clear relationship between the occurrence of corrosion and edge radii," within the limits of their experiments. They also concluded that "the effect of surface preparation, paint application method and atmospheric conditions were of greater overall significance than the effect of rounding off the edges." This observation seams to be contradicted by the findings of the Russian stuay, which was much more extensive. Both the Swedish and Russian studies were aone about the same time (1976-1977), independently.

Since the Russian investigation appears to be more systematic, extensive, carefully controlled and far more detailed than the Swedish work in terms of bevel angles, film thicknesses, surface preparations coating system types and environmental factors, their overall findings are therefore quite reasonably plausible with respect to under what conditions edge preparation becomes important and when it does not.

All in all, given the optimum surface preparation technique, application method and a specific environment, it appears as though the sharper the edge radius for a given generic paint system, the faster the edge will corrode. And this very same observation is also evident in the qualitative answers provided in the questionnaires.

The most common technique for rounding off sharp edges is grinding. The extent of rounding off is usually stated in descriptive terms such as "suitable profile" or "smooth to the touch", rather than quantitative terms.

A.2.2. Surface Discontinuities

Discontinuities in flat surfaces consist of

laps,	cavities or pits,
folds,	scars,
seams,	rough welds,
flakes,	undercuts,
laminations,	mill scale,
slag inclusions,	rust,
	cracks,

When surface discontinuities are considered significant to affect the integrity of the protective coating, the method of repair listed in order of severity may be as follows,

- grinding to remove the defect,
  preparation of the defective area for fill-in with a compound of one kind or another,
  preparation of the defective area (by grinding or gouging) and fill-in by welding followed by grinding flush with the surface,
  sectional cut-out and/or renewal with insert plate.

The criterion by which a surface discontinuity is deemed to be significant is not clearly defined. What in general is viewed to be a defect requiring some kind of a repair method include cracks, shells, sand patches and sharp edged seams. The Committee of International Association of Classification Societies (IACS) in October 1982, London issued a document called "Guideline four Surface Finish of Hot Rolled Steel Plates and Wide Flats." This final draft is the end result of proposal originally put together by Lloyds of Germany, (Germanischer Lloyd) which was approved by IACS. The document deals with flat surfaces exclusively. Edge preparation is not addressed in this guideline document. The highlights of this document is as follows,

The repair methods according to this document can be divided into two categories:

1. Grinding and
2. Welding.

Grinding is for fixing shallow surface defects provided that the thickness of the plate is not reduced by more than 7% or 3mm (0.12 in); whichever is less. Each single ground area should not exceed 0.25 m^2 (2.7 ft^2). The allowable total surface area fixed by grinding should not exceed 2% of the total area of the plate in question.

Melding is for repairing defects that are more severe than those corrected by grinding only. Any single weld repaired area is not to exceed .125m^2 (1.35 ft^2). The sum of all areas repaired by grinding ought not to be more than 2% of surface side in question. The defective area has to be so prepared that 3 parallel weld beads be required to fill in the groove. The welds must be built up so that the reinforcement will have to be ground flush with the plate surface. No single pass, stringer bead is allowed. Weld preparation should not reduce the plate thickness below 80% of the nominal value. The full text of IACS document can be found in the Annex. The weld repaired area is to be inspected by UT, MP or PT. Postweld heat treatment is contingent upon grade of steel involved and the discretion of the inspector and/or attending surveyor. A caution is in order here. Care has to be exercises in weld repair situations so that while the surface may be excellent from a painting point of view, the properties of the steel plate is not

significantly affected by introducing "metallurgical discontinuities" which may only later-on in service manifest themselves in base plate cracking as a result of the combines action of microstructural degradation, introduction of discontinuities, and high tensile residual stresses.

Some of the metallurgical discontinuities cannot readily be detected by conventional and routine NDE methods. Furthermore, the insidious nature of residual stress is that its presence generally goes unnoticed. Extensive weld repair particularly under conditions of high restraint can result in tensile residual stress of yield strength magnitude of the base plate involved. (7)

B) Questionnaires:

A sample of the cover letter and blank questionnaire can be seen in Annex (b). The results of the questionnaires received are presented in Table I in detail. [Annex (c)]. Accordingly, opinions vary on what constitutes a sharp edge. The majority of the respondents indicated that there were contractual requirements on sharp edges ranging from grinding to striping or brush coating. On the question of defective flat surfaces, the majority said again that the contract usually specified repair methods. The type of repair depended on the severity of the defect.

About one half of the people showed awareness of standards nothing other than NAVSHIPS 0500-999-9000, ANSI A159.1-1972 (SSPC-1O, SSPC-6) for surface preparation. No edge preparation standard exists currently in this country. Apparently, no one in the U.S.A. knew about the Swedish standard VIS 675 and VIS 806 and Italcantieri's PL90113A. [See Annex (d) and (e) for the original texts, respectively] France and Japan are two other countries which have edge preparation standards. [Annex (f) and (g)].

The solution for sharp edges when required by agreement is grinding without specifically stating the radius of curvature, as far as U.S. respondents were concerned. In Japan, the IHI practice for example spells out a radius range of 1-3 mm (0.04-0.12 in) for product carriers only. No edge preparation (rounding off) is required for black and crude oil carriers. Similarly, there is no grinding requirement on formed material, as a rule, since it is believed to be rounded enough "as is" for most situations. The SAJ standards issued in April, 1982 state that sharp edges or plate burr

caused by gas cutting be removed by a grinder or disc sender to a bevel of 1-2 mm (0.04 - 0.08 in) for product carriers. The inspection of this bevel requirement is done by visual means. The full texts of “Tank Coatings Specifications for Product Carriers”, and “Quality and Inspection Standard of De-rusting” can be found in the Annex to this report. The summary page of the French Standard IRCN is also appended. There was a wide array of fixes as indicated by the respondents for correcting defects in flats. The answer to overcoating sharp edges in an attempt to delay the onset of corrosion was a predominant yes, although quite a few stated that such a practice would not extend the useful life of the protective system. The reply to overcoating defects in flats was just about split between “Yes” and “No”. Those who gave “No” answers said that their solution for scars was one of filling or grinding or welding depending on defect severity.

All the respondents said that the inspectors and the fabricators work out some sort of accommodation when faced with a given problem. Interestingly enough one respondent mentioned. that shipyards and paint manufacturers are “comnonly in conflict.”

One of the most revealing range of answers was given to the question of what is the biggest problem with sharp edges and flat surfaces. The essence of the variously stated sharp edge problems is PREMATURE RUSTING regardless of what is being done short of providing an adequate radius and/or level. Likewise, the substance of trying to fix a given defect on flat surfaces is an early sign of breakdown in the coating system at the location of the defect either in the steel or in the paint system at holidays or thin film sites. The concern over problems associated with sharp edges and defective flats stems from the high and unpredictable costs involved in fixing these problems.

There was a very strong overall sentiment expressed for developing standards on edge and surface preparations.

A few interesting points are worthy of highlighting here which are taken from the section on “Additional Comments”.

- Foreign countries prefer to work to international standards as opposed to industry or national standards.
- Developing and/or recommending a set of standards should be a part of this present study (project).
- The new philosophy should be to design for application and maintenance of coating systems.
- Standards are certainly required and are in dire need.

V. RECOMMENDATION

On the basis of the positive results obtained in Phase I of this project, it is recommended that a test program be readily initiated as Phase II. This test program should have a dual purpose:

1. Quantify the effects of radius of curvature and/or bevel angle on coating performance along edges applying different paint systems currently used in U.S. shipyards, and
2. Develop the framework for suggesting edge preparation standards.

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ANNEX

Germanischer

GUIDELINES FOR SURFACE [illegible] ROLLED STEEL PLATES A[illegible]

(Final Draft October 19[illegible]

(a)

. surface discontinuity is deemed to be
at in general is viewed to be a defect
include cracks, shells, sand patches a

GUIDELINES FOR SURFACE FINISH OF HOT ROLLED STEEL PLATES AND WIDE FLATS

(Final Draft October 1982)

The repair methods according to this document can be divided into two

These guidelines give some criteria recommended for the surface finish for hull structural steel plates and wide flats in accordance with UR-W 11 (UR-162) as well as the treatment of imperfections and defects which may occasionally occur on the surfaces of these products. They do not cover quality requirements for the edges.

At the individual Society's discretion these guidelines may also be applied to other steel grades.

Note

The criteria contained herein have been based on the consideration that surface imperfections and defects on hull steels may impair the proper coating of tanks and hulls and this may reduce the corrosion resistance.

Moreover, they may increase the frictional resistance of the hull and thereby impair the economy of the service. Surface defects may also adversely affect the strength of the structure. Special provisions with respect to the surface finish are therefore deemed necessary.

2. Manufacturer's Responsibility

The responsibility for the required surface finish rests with the manufacturer of the material, who is to take the necessary precautions and to inspect the products prior to delivery. At that stage, however, rolling or heat treatment scale may conceal surface discontinuities. If, during the subsequent descaling or working operations, the material i-s found to be defective, the surveyor may require materials to be repaired or rejected.

3. Acceptance Criteria

3.1 General Surface Finish

All products must have a workmanlike finish and must be free from defects and imperfections which may impair their proper workability and use. This may, however, include some discontinuities of harmless nature, e.g. , pittings, rolled-in scale, indentations, roll marks, scratches and grooves which cannot be avoided completely despite proper manufacturing and which will not be objected to.

3.1 Imperfections

Notwithstanding this, the products may have imperfections exceeding the discontinuities inherent to the manufacturing process, as defined under item 3.1. In this case limits for their acceptability are to be agreed with the individual Society, taking the use of the product into consideration.

3.3 Defects

Cracks, shells", sand patches and sharp edged seams are always considered as defects which impair the use of the product and which require rejection of repair irrespective of their size and number. The same applies *to* imperfections exceeding the acceptable limits.

4. Repair Procedure

4.1 Grinding

4.1.1 Grinding may be applied provided:-

a) the nominal product thickness will not be reduced by more than 7% or 3mm, whichever is the less,
b) each single ground area does not exceed 0.25 m^2 and
c) their sum does not exceed 2% of the surface in question.

Ground areas lying in a distance less than their average breadth to each other are to be regarded as one single area.

4.1.2 Ground areas lying opposite each other on both surfaces must not decrease the product thickness by values exceeding the limits as stated under 4.1.1.

4.1.3 The defects or unacceptable imperfections are to be completely removed by grinding.

The ground areas must have smooth transitions to the surrounding surface of the product. Complete elimination of the defects may be verified by magnetic particle or dye penetrant test procedures at the Surveyor's discretion.

4. 1.4 Where necessary, the whole surface may be ground to a depth as given by the under thickness tolerance of the product.

4.2 Welding Repair

Local defects which cannot be repaired by grinding as stated under 4.1 may be repaired with the Surveyor's consent by chipping and/or grinding followed by welding subject to the following conditions:

4.2.1 Any single welded area shall not exceed 0.125 m^2 and the sum of all areas shall not exceed 2% of the surface side in question.

The distance between two welded areas shall not be less than their average width.

4.2.2 The weld preparation must not reduce the thickness of the product below 80% of the nominal thickness. For occasional defects with depths exceeding the 80% limit, special consideration at the Surveyor's discretion will be necessary.

4.2.3 The repair shall be carried out by qualified welders using an approved procedure for the appropriate steel grade. The electrodes shall be of low hydrogen type and must be dried in accordance with the manufacturer's requirements and protected against dehumidification before and during welding.

4.2.4 All weldings are to be of reasonable length and must have at least 3 parallel welding beads. The deposited metal must be sound, without any lack of fusion, undercut, cracks and other defects which could impair the workability or use of the product.

Welding is to be performed with one layer of beads in excess, which is subsequently to be ground smooth to the surface level.

4.2.5 Products which are to be supplied in a heat treated condition are to be welded prior to the heat treatment; otherwise, a new heat treatment may be required.

Products supplied in the controlled rolled *or* as rolled condition may require a suitable heat treatment after welding. However, the post weld heat treatment may be omitted provided the manufacturer has demonstrated by a procedure test that the required properties will be maintained without heat treatment.

4.2.6 The finished products are to be presented to the Surveyor for acceptance. The soundness of the repair may be verified by ultrasonic, magnetic particle or dye penetrant methods at the Surveyor's discretion.

4.2.7 For every welding repair the manufacture must provide the Surveyor with a written report and a sketch showing sizes and location of the defects and full details of the repair procedure including the welding consumables, post weld heat treatment and non-destructive testing.

ANNEX B

(b)

Dear :

The attached QUESTIONNAIRE is sent to you for the sole purpose of soliciting information and/or data for a project entitled "Investigation of the Application of Protective Coatings in Tankers." Thevstudy iS sponsored by the United States Maritime Administration, Washington, DC.

The aim with the project is to develop a standardized edge and surface preparation practice so as to avoid premature failure in the protective coating system at sharp edges and local defects in flat steel surfaces: hence savings in reduced maintenance and minimization of cargo contamination.

This survey is designed to include shipbuilders, owner/operators and marine paint manufacturers. Your help will be much appreciated.

It is through such cooperative efforts that the shipbuilding community is so greatly benefited.

We ask that you return the filled out questionnaire and any other supplemental information or document, which you may wish to provide for this project, at your earliest convenience.

On behalf of the sponsors, thank you for your cooperation.

Sincerely,

Dr. L. W. Sander
Manager
Materials Technology

cc: J. Peart, MARAD Program manager
SNAME 023-1

July 12, 1982

QUESTIONNAIRE

The purpose of this questionnaire is to collect information and/or data with a view towards determining what is being done on preparation of edges and defective surfaces of steel plates used in shipbuilding prior to painting.

The survey is intended to include shipbuilders, owner/operators and marine paint manufacturers. The information and/or data obtained through this survey will be analyzed and published in the final report of project #5699, which is sponsored by the U.S. Maritime Administration through SNAME 023-1. The ultimate objective of this study is to recommend a practice which may eventually lead to a national or an industrial standard on edge preparation.

1. What is an edge which is considered to be too sharp to permit to paint in ships?

   Answer:

2. Is there any contractual requirement on

   2.1 sharp edges

   Answer:

   2.2 preparation of defective surfaces

   Answer:

3. Is there a standard to which edges and/or surfaces must be prepared

Answer:

4. What do you do when you face a problem with

4.1 sharp edges

Answer:

4.2 defects in flat surfaces

Answer:

5. Do you overcoat when you are faced with a problem of

5.1 sharp edges

Answer:

5.2 defects such as scars in the steel

Answer:

6. Do you have your inspector and the fabricator come to an agreement?

Answer:

6.1 If your answer is “yes”, what kind of an agreement do they usually reach?

Answer:

7. Do you involve either the paint manufacturer or the painting contractor or both in the agreement negotiations?

Answer:

8. What is your biggest problem with

8.1 sharp edges

Answer:

8.2 flat surfaces

Answer:

9. How do you resolve your single biggest problem with

901 sharp edges

Answer:

9.2 defective flat surfaces

Answer:

10. Do you know of any shipyard or of a shipbuilding nation which may have an edge preparation standard?

    10.1 Name and address of shipyard:

    10.2 Name of the country (countries)

    10.3 Can you provide a copy of such standards?

11. Would it benefit you to have a national and/or an industrial standard on preparation of edges and flats?

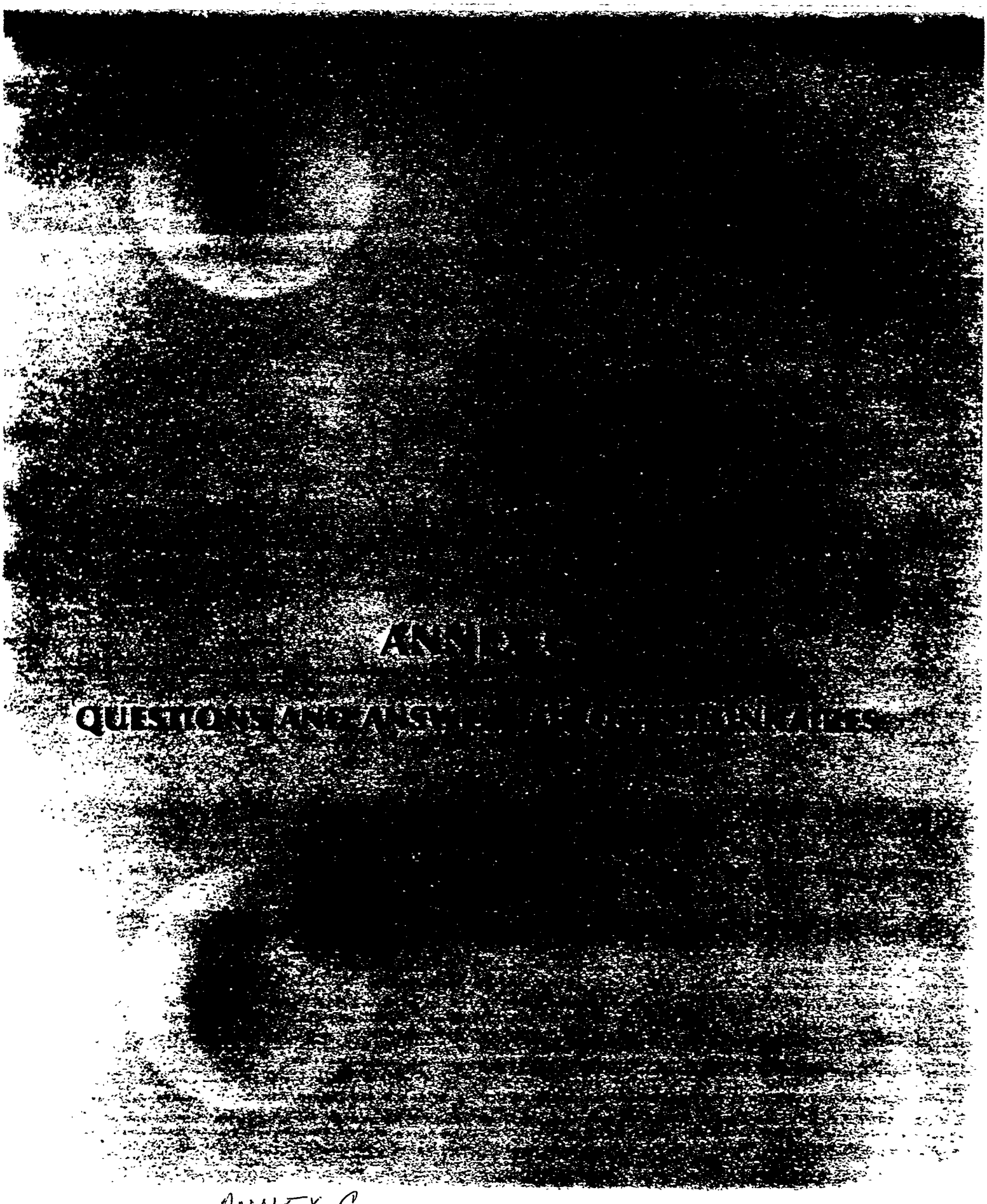
Answer:

12. Do *you* have any other additional comments, information, data, and documents and guidelines to provide for this study, which is designed to serve your interest?

    Comments:

On behalf of the U.S. Maritime Administration and SNAME 023-1, thank you for your help and cooperation.

Dr. L. W. Sandor, Manager
Materials Technology
PROCESS TECHNOLOGY DEPT.
Franklin Research Center
Philadelphia, PA 19103



ANNEX C

QUESTIONS AND ANSWERS OF QUESTIONNAIRES

TABLE I

Questions and Answers of Questionnaires
(identical answers named only once in this listing)

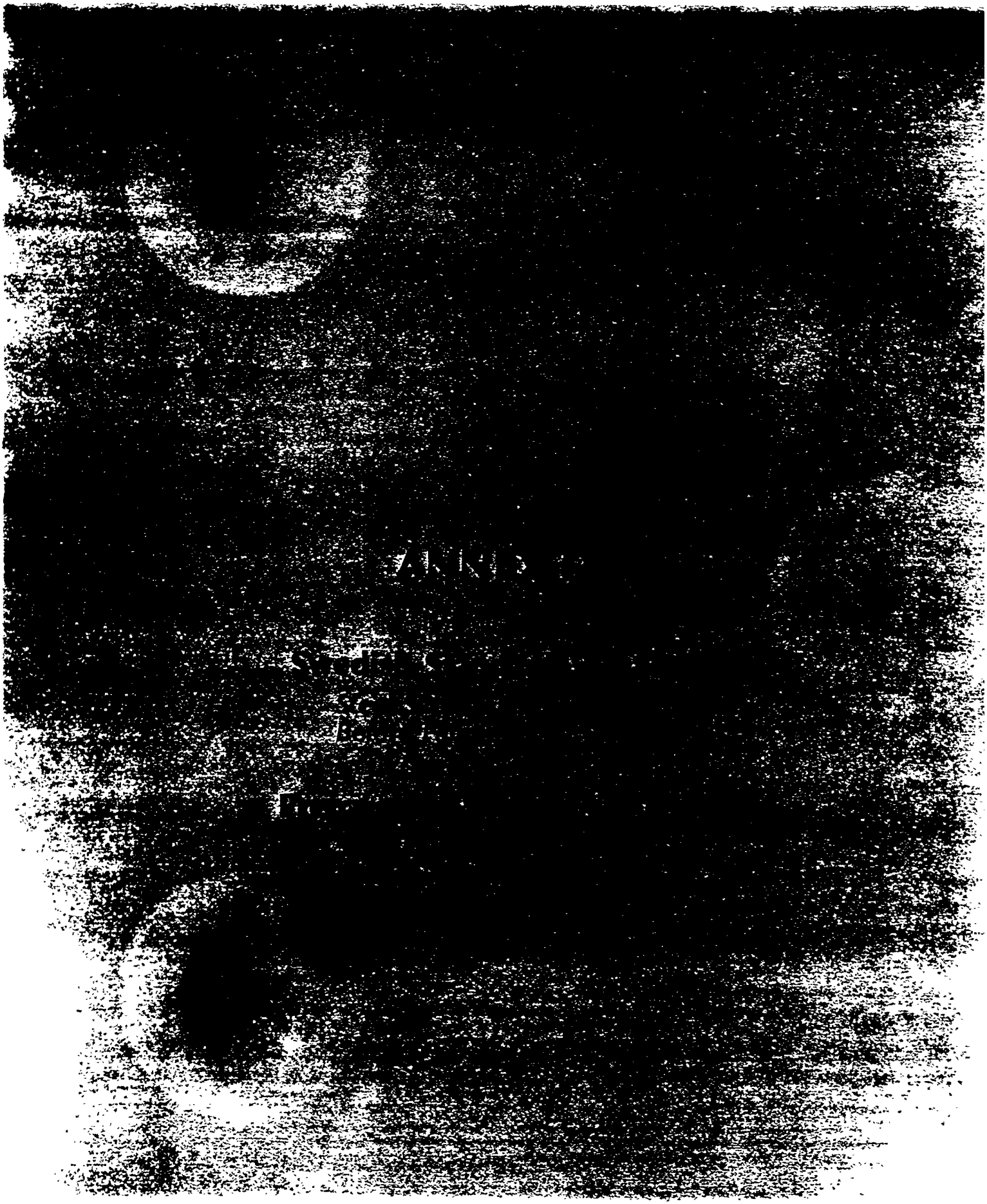
No.	Questions	Answers
1	What is considered to be a sharp edge	Flame cut corners, Jagged edges causing injury, Edge radii less than 1 mm, 1/32", 1/16" or 1/8" for tank linings: 1/16" or 1/8" for non-immerse service: 1 mm, 1/32" or 1/16" (elsewhere) Exposed edges of flat bars, angles, web plates, channels and sheet metal Depends on type of coating supplied and tank location
2	Is there any contractual requirement on	Yes - dominant answer
	(a) Sharp Edges	
	(b) Defective Surfaces	Yes - dominant answer
3	Is there a standard to which edges and/or surfaces must be prepared	Yes and No (about 50/50 basis) When "Yes" - NAVSHIPS 0900-999-9000 ASI AI59.1-1972, SSPC-10, SSPC-6 Swedish Std. VIS 673, VIS 806
4	What do you do when faced with a problem of	
	(a) Sharp Edges	Grinding: sheared or torch cut edges (without radius given). 1-3 mm radius for product carriers only. No grinding: black and crude oil carriers, formed material
	(b) Defective Surfaces	Grinding, welding, overspraying, compounds (bellzone, red hand, filled bond), insert plate, blasting, striping, wire brushing.

(Table I - Continued)

5	Do you overcoat when faced with	
	(a) Sharp Edges	Yes - majority of answers
	(b) Defective Surfaces	Yes and No (about 50/50 basis)
6	Do inspectors and fabricators come to an agreement	All said “Yes”
7	Are paint manufacturers involved in the agreement	Yes - dominant answer One answer stated, “Shipyards and paint manufacturer are commonly in conflict.”
8	What is the biggest problem with	Meet film thickness requirement,
	(a) Sharp Edges	Rapid paint breakdown, Nonuniform film thickness along sharp and jagged edges, Define what an owner considers-a sharp edge, Increase in manpower required to brush coat around holes, Cost involved.
	(b) Defective Surfaces	No film thickness gages capable of scanning the entire flat surface to check coating uniformity, Removal of temporary attachments, Pitting of old steel, Film thickness variation, Defects sometimes show up only after sandblasting Laminations, Pin point rusting, Corrosion, Holidays in areas of weld pin holes, spatter, Paint delamination, Determine what owner considers a defective surface, cost l

(Table I - continued)

9	How do you resolve your single biggest problem with	
	(a) Sharp Edges	Grinding - by far the predominant answer Brush coating, Striping, More careful cutting, Increase film thickness.
	(b) Defective Surfaces	Welding and grinding smooth - predominant answer Reblasting, Spot coating by hand brushing, Re-prepare surface and touch-up, Fill-in epoxy compound, Stripe coat.
10	Do you know of any shipyard or shipbuilding nation which may have an edge preparation standard	No - overwhelming answer Sweden, Italy, possibly France and Japan
11	Is there any benefit to having standards on edges and flats	Yes - predominant answer Some of the provisions and comments were as follows, o avoid unnecessary effort (i.e., reasonable stds.), o single std. will not cover all applications and customer requirements (domestic, foreign, naval), o stds should be internation in scope, o stds should allow shipyards to compete on equal basis, o stds would minimize the differing opinions between owners, inspectors, suppliers, applicators, o stds should be suitable for production utilization, o edge preparation requirements vary largely, o subject to paint manufacturer's unified agreement.
12	Do you have any other additional comments	Foreign countries prefer international standards. Stds are very much needed for shipyard work for the best interest and protection of all parties concerned. Design for application and maintenance of coating systems. As part of this study (project), consider recommending a std.



ANNEX B

Swedish Standard VIS 806

Steel Surface Preparation

VIS VARVSINDUSTRINS STANDARDCENTRAL **VARVSSTANDARD VIS 806**

GÄLLER FRÅN	UTGÅVA	KLASS	SIDA
1975-10-01	1	0544.0202	1 (5)

Förbehandling av stålyta före målning

Förbehandlingssystem

Steel surface preparation before painting
Preparation systems

Innehåll

1 Orientering

2 Tillämpningsexempel

3 Förbehandlingssystem

1 Orientering

Denna standard anger olika system för förbehandling av stålyta före målning med tillämpning av VIS 673 Förbehandling av stålyta före målning, klass 0544.0201. Krav på bestämd ordningsföljd för respektive systems förbehandlingsmoment föreligger dock ej.

Standarden är avsedd att tillämpas för stålytor på fartyg före slutmålning.

Begränsning av antalet förbehandlingssystem har ej eftersträvats, främst med hänsyn till skilda resurser och andra omständigheter vid olika varv och verkstäder.

2 Tillämpningsexempel

Förbehandlingssystem enligt punkt 3 sid 2 och 3 tillämpas exempelvis enligt följande.

AA	för ytor bakom garnering i inredning, torrtankar etc.
BA, BB, BC	för ytor i kofferdammar, tankar, maskinrum, däckshus etc.
CA, CB, CC	för ytor i likhet med BA, BB och BC men där högre kvalitet på förbehandling önskas samt som ersättning för blästring vid reparationsarbeten i samband med avancerade målningssystem.
DA	för ytor i likhet med BA, BB och BC men där högre kvalitet på förbehandling önskas.
EA, EB, EC	för ytor i likhet med BA, BB och BC men där mycket högre kvalitet på förbehandling önskas.
FA	för ytor där vissa högeffektiva korrosionsskydd skall tillämpas.

Contents

1 Introduction

2 Examples of application

3 Preparation systems

1 Introduction

This standard presents various systems of steel surface preparation before painting, with the application of VIS 673 Steel surface preparation before painting, class 0544.0201. However, there are no requirements for a definite sequence for the treatment phases of the respective system.

The standard is intended for steel surfaces on ships before final painting.

The aim has not been to limit the number of preparation systems, mainly because of disparate resources and other circumstances at different shipyards and shops.

2 Examples of application

Preparation system as per par. 3, page 4 and 5, for example, to be applied according to the following.

AA	for surfaces behind planking in accomodation, dry tanks etc.
BA, BB, BC	for surfaces in cofferdams, tanks, engine rooms, deck houses etc.
CA, CB, CC	for surfaces, similar to BA, BB and BC, but where a higher quality of the preparation is desired, and as replacement for blasting at repair works in connection with advanced painting systems.
DA	for surfaces, similar to BA, BB and BC, but where a higher quality of the preparation is desired.
EA, EB, EC	for surfaces, similar to BA, BB and BC, but where a much higher quality of the preparation is desired.
FA	for surfaces, where certain highly effective protection treatments against corrosion should be applied.

3 Förbehandlingssystem

Beteckning	1 Blästring	2 Shopprimer	3 Svetsskarvar	4 Svetssprut	5 Skarpa kanter efter stansning och klippning
AA	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.5 Lätt stålborstning	4.3 Svetssprut åtgärdas ej	5.2 Ingen kantbrytning
BA	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.4 St 2 enligt SIS 05 59 00-1967	4.2 Löst sittande svetssprut avlägsnas	5.2 Ingen kantbrytning
BB	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.4 St 2 enligt SIS 05 59 00-1967	4.2 Löst sittande svetssprut avlägsnas	5.2 Ingen kantbrytning
BC	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.4 St 2 enligt SIS 05 59 00-1967	4.2 Löst sittande svetssprut avlägsnas	5.2 Ingen kantbrytning
CA	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.3 St 3 enligt SIS 05 59 00-1967	4.2 ~~Löst sittande~~ svetssprut avlägsnas	5.2 Ingen kantbrytning
CB	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.3 St 3 enligt SIS 05 59 00-1967	4.2 Löst sittande svetssprut avlägsnas	5.2 Ingen kantbrytning
CC	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.3 St 3 enligt SIS 05 59 00-1967	4.2 Löst sittande svetssprut avlägsnas	5.1 Lätt kantbrytning
DA	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.2 (1.3) Sa 2 enl SIS 05 59 00-1967	4.2 Löst sittande svetssprut avlägsnas	5.2 Ingen kantbrytning
EA	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.2 (1.2) Sa 2 1/2-2 enligt SIS 05 59 00-1967	4.2 Löst sittande svetssprut avlägsnas	5.2 Ingen kantbrytning
EB	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.2 (1.2) Sa 2 1/2-2 enligt SIS 05 59 00-1967	4.2 Löst sittande svetssprut avlägsnas	5.1 Lätt kantbrytning
EC	1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00-1967	2 Shopprimer enligt anvisning	3.1 Slaggrester avlägsnas 3.2 (1.2) Sa 2 1/2-2 enligt SIS 05 59 00 - 1967 3.6 Spetsiga toppar jämnas 3.7 Synliga fickor och porer åtgärdas.	4.1 Svetssprut avlägsnas	5.1 Lätt kantbrytning
FA	1.1 Sa 3 - 2 1/2 enligt SIS 05 59 00-1967	—	3.1 Slaggrester avlägsnas 3.2 (1.1) Sa 3-2 1/2 enligt SIS 05 59 00 - 1967 3.6 Spetsiga toppar jämnas 3.7 Synliga fickor och porer åtgärdas	4.1 Svetssprut avlägsnas	5.1 Lätt kantbrytning

6 Skarpa kanter efter bränning	7 Defekter i stålyta	8 Skadad shopprimer och icke shopprimerbehandlad yta	9 Bättring av shopprimerbehandlad yta	10 Rengöring av shopprimerbehandlad yta
6.1 Slaggrester avlägsnas	7.4 Defekter i stålytan åtgärdas ej	8.4 (3.5) Lätt stålborstning	9.2 Ingen bättring	10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas	7.4 Defekter i stålytan åtgärdas ej	8.4 (3.5) Lätt stålborstning	9.2 Ingen bättring	10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas	7.4 Defekter i stålytan åtgärdas ej	8.3 St 2 enligt SIS 05 59 00-1967	9.2 Ingen bättring	10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas	7.4 Defekter i stålytan åtgärdas ej	8.3 St 2 enligt SIS 05 59 00-1967	9.1 Bättring med primer enligt anvisning	10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas	7.4 Defekter i stålytan åtgärdas ej	8.3 St 2 enligt SIS 05 59 00-1967	9.1 Bättring med primer enligt anvisning	10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas	7.4 Defekter i stålytan åtgärdas ej	8.2 St 3 enligt SIS 05 59 00-1967	9.1 Bättring med primer enligt anvisning	10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas 6.3 (5.1) Lätt kantbrytning	7.4 Defekter i stålytan åtgärdas ej	8.2 St 3 enligt SIS 05 59 00-1967	9.1 Bättring med primer enligt anvisning	10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas	7.4 Defekter i stålytan åtgärdas ej	8.1 (1.3) Sa 2 enl SIS 05 59 00-1967	9.2 Ingen bättring	10.1 Svepblästring 10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas	7.4 Defekter i stålytan åtgärdas ej	8.1 (1.2) Sa 2 1/2-2 enl SIS 05 59 00-1967	9.1 Bättring med primer enligt anvisning	10.1 Svepblästring 10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas 6.3 (5.1) Lätt kantbrytning	7.4 Defekter i stålytan åtgärdas ej	8.1 (1.2) Sa 2 1/2-2 enl SIS 05 59 00-1967	9.1 Bättring med primer enligt anvisning	10.1 Svepblästring 10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas 6.2 (3.6) Spetsiga toppar på snittytan jämnas 6.3 (5.1) Lätt kantbrytning	7.1 Synliga ytfel, vassa kanter och grader vid intryckningar nedslipas 7.2 Brännsår bortsmärglas 7.3 Mjuka, runda defekter åtgärdas ej	8.1 (1.2) Sa 2 1/2-2 enl SIS 05 59 00-1967	9.1 Bättring med primer enligt anvisning	10.1 Svepblästring 10.2 Avfettning 10.3 Annan rengöring 10.4 Damning
6.1 Slaggrester avlägsnas 6.2 (3.6) Spetsiga toppar på snittytan jämnas 6.3 (5.1) [illegible] kantbrytning	7.1 Synliga ytfel, vassa kanter och grader vid intryckningar nedslipas 7.2 Brannsår bortsmarglas 7.3 Mjuka, runda defekter åtgardas ej	—	—	—

3 Preparation systems

Designation	1 Blasting	2 Shop primer	3 Welded joints	4 Weld spatter	5 Sharp edges after punching and cutting
AA	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.5 Light wire-brushing	4.3 Nothing to be done to weld spatter	5.2 No chamfering
BA	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.4 St 2 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.2 No chamfering
BB	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.4 St 2 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.2 No chamfering
BC	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.4 St 2 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.2 No chamfering
CA	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.3 St 3 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.2 No chamfering
CB	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.3 St 3 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.2 No chamfering
CC	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.3 St 3 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.1 Light chamfering
DA	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.2 (1.3) Sa 2 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.2 No chamfering
E	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.2 (1.2) Sa 2 1/2-2 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.2 No chamfering
EB	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.2 (1.2) Sa 2 1/2-2 according to SIS 05 59 00-1967	4.2 Loose spatter to be removed	5.1 Light chamfering
EC	1.2 Sa 2 1/2-2 according to SIS 05 59 00-1967	2 Shop primer according to directions	3.1 Slag to be removed 3.2 (1.2) Sa 2 1/2-2 according to SIS 05 59 00-1967 3.6 Sharp peaks to be smoothed 3.7 Visible pockets and pores to be treated	4.1 Weld spatter to be removed	5.1 Light chamfering
FA	1.1 Sa 3-2 1 2 according to SIS 05 59 00-1967	—	3.1 Slag to be removed 3.2 (1.1) Sa 3-2 1 2 according to SIS 05 59 00-1967 3.6 Sharp peaks to be smoothed 3.7 Visible pockets and pores to be treated	4.1 Weld spatter to be removed	5.1 Light chamfering

The ... (1.1, 1.2, 2, 3, 4 etc) refer to VIS 8?? steel surface

6 Sharp edges after flame cutting	7 Defects in steel surface	8 Damaged shop primer and surface not treated with shop primer	9 Touching up of shop primed surface	10 Cleaning of shop primer treated surface
6.1 Slag to be removed	7.4 Defects in steel surface not to be treated	8.4 (3.5) Light wire-brushing	9.2 No touching up	10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed	7.4 Defects in steel surface not to be treated	8.4 (3.5) Light wire-brushing	9.2 No touching up	10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed	7.4 Defects in steel surface not to be treated	8.3 St 2 according to SIS 05 59 00-1967	9.2 No touching up	10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed	7.4 Defects in steel surface not to be treated	8.3 St 2 according to SIS 05 59 00-1967	9.1 Touching up with primer in accordance with directions	10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed	7.4 Defects in steel surface not to be treated	8.3 St 2 according to SIS 05 59 00-1967	9.1 Touching up with primer in accordance with directions	10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed	7.4 Defects in steel surface not to be treated	8.2 St 3 according to SIS 05 59 00-1967	9.1 Touching up with primer in accordance with directions	10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed 6.3 (5.1) Light chamfering	7.4 Defects in steel surface not to be treated	8.2 St 3 according to SIS 05 59 00-1967	9.1 Touching up with primer in accordance with directions	10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed	7.4 Defects in steel surface not to be treated	8.1 (1.3) Sa 2 according to SIS 05 59 00-1967	9.2 No touching up	10.1 Sweep blasting 10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed	7.4 Defects in steel surface not to be treated	8.1 (1.2) Sa 2 1/2-2 according to SIS 05 59 00-1967	9.1 Touching up with primer in accordance with directions	10.1 Sweep blasting 10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed 6.3 (5.1) Light chamfering	7.4 Defects in steel surface not to be treated	8.1 (1.2) Sa 2 1/2-2 according to SIS 05 59 00-1967	9.1 Touching up with primer in accordance with directions	10.1 Sweep blasting 10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed 6.2 (3.6) Sharp peaks on section surface to be smoothed 6.3 (5.1) Light chamfering	7.1 Visible surface defects, sharp edges and burrs at indents to be ground 7.2 Burnt areas to be ground 7.3 Smooth round defects not to be treated	8.1 (1.2) Sa 2 1/2-2 according to SIS 05 59 00-1967	9.1 Touching up with primer in accordance with directions	10.1 Sweep blasting 10.2 Degreasing 10.3 Other type of cleaning 10.4 Dusting
6.1 Slag to be removed 6.2 (3.6) Sharp peaks on section surface to be smoothed 6.3 (5.1) Light chamfering	7.1 Visible surface defects, sharp edges and burrs at indents to be ground 7.2 Burnt areas to be ground 7.3 Smooth round defects not to be treated	—	—	—

VIS VARVSINDUSTRINS STANDARDCENTRAL **VARVSSTANDARD VIS 673**

GÄLLER FRÅN	UTGÅVA	KLASS	SIDA
1973-11-15	1	0544	1 (3)

Förbehandling av stålyta före målning

Steel surface preparation before painting

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3 Svetsskarvar
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6 Skarpa kanter efter bränning
7 Defekter i stålyta
8 Skadad shopprimer och icke shopprimerbehandlad yta
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10 Rengöring av shopprimerbehandlad yta

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3 Welded joints
4 Spatter
5 Sharp edges after punching and cutting
6 Sharp edges after flame cutting
7 Defects in steel surface
8 Damaged shop primer and surface not treated with shop primer
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Orientering

Denna standard anger olika metoder för förbehandling av stålyta före målning samt noggrannhetsgraden för respektive förbehandling.

Olika färgsystem kräver olika förbehandling av stålytan. Vid angivande av förbehandling hänvisas till de alternativ i denna standard som avses användas för ifrågavarande färgsystem.

Introduction

This standard presents various methods of preparation of steel surface before painting, and also grade of preparation for respective treatments.

Various paint systems require different preparations of the steel surface. When stating preparation, reference is made to the alternatives in this standard, intended to be used for the paint system in question.

1 Blästring

1.1 Sa 3 - 2 1/2 enligt SIS 05 59 00 - 1967.

Förutsätter fristråleblästring.
Sa 3 kan normalt ej uppnås genomgående.

1.2 Sa 2 1/2 - 2 enligt SIS 05 59 00 - 1967.

Blästring enligt 1.2 är vad som normalt uppnås i automatisk blästringsstation.

1.3 Sa 2 enligt SIS 05 59 00 - 1967.

1 Blasting

1.1 Sa 3 - 2 1/2 according to SIS 05 59 00 - 1967.

Airblasting implied..
Normally, Sa 3 cannot be attained throughout.

1.2 Sa 2 1/2 - 2 according to SIS 05 59 00 - 1967

Blasting according to 1.2 is what normally can be attained in automatic blasting station.

1.3 Sa 2 according to SIS 05 59 00 - 1967.

2 Shopprimer

Shopprimer påföres omedelbart efter blästring.
Beteckningen kompletteras med färgbeteckningen jämte

2 Shop primer

Shop primer to be applied immediately after blasting.
The designation to be completed with paint designation and dry film thickness.

3 Svetsskarvar

3.1 Slaggrester avlägsnas.
Slagg förutsätts vara avlägsnat i samband med svetsning.

3.2 Blästring enligt punkt 1.
Lämplig grad anges. Ex - 1.2.

3.3 St 3 enligt SIS 05 59 00 - 1967.

3.4 St 2 enligt SIS 05 59 00 - 1967.

3.5 Lätt stålborstning.
Stålborsten förs med lätt tryck fram och tillbaka så att varje del av ytan blir borstad två gånger.

3.6 Spetsiga toppar jämnas.
Med spetsiga toppar förstås sådana ojämnheter som känns skarpa eller spetsiga vid beröring med bar hand. Skarpa kanter eller dylikt får ej uppstå vid jämningen. Maskinsvetsar och väl lagda handsvetsar åtgärdas normalt ej.

3.7 Synliga fickor och porer som kan förorsaka korrosionsgömmor, eller förhindra färgens vätning, görs åtkomliga eller isvetsas och jämnas enligt punkt 3.6.

3 Welded joints

3.1 Slag to be removed.
It is implied slag to be removed in connection with welding.

3.2 Blasting according to 1.
Suitable grade to be stated. Ex. - 1.2.

3.3 St 3 according to SIS 05 59 00 - 1967.

3.4 St 2 according to SIS 05 59 00 - 1967.

3.5 Light wire-brushing.
The wire brush to be moved back and forth under light pressure so the surface will be brushed twice.

3.6 Smoothing of sharp peaks.
With sharp peaks are understood such irregularities as feel sharp or pointed when touched with bare hand. Sharp edges etc may not arise at smoothing. Automatic and well done manual welds normally do not need attention.

3.7 Visible pockets and pores that may cause corrosion concealments [illegible]vent the wetting of the paint, to be made accessible [illegible]ed up and smoothed acc. to 3.6.

4 Svetssprut

4.1 Svetssprut avlägsnas.
Stålskrapa med härdad egg kan därvid vara lämplig.

4.2 Löst sittande svetssprut avlägsnas.
Kvarsittande svetssprut avlägsnas ej.

4.3 Svetssprut åtgärdas ej.

4 Weld spatter

4.1 Weld spatter to be removed.
Hand scraper with hardened edge should be used.

4.2 Loose spatter to be removed.
Remaining spatter not to be removed.

4.3 Nothing to be done to weld spatter.

5 Skarpa kanter efter stansning och klippning

5.1 Lätt kantbrytning.
Kantbrytningen utförs exempelvis med fil eller handslipmaskin som med lätt tryck förs en eller två gånger över kanten. Nya skarpa kanter får därvid ej uppstå.
Normalt åtgärdas endast släppsidan av ett hål eller kant.
Med skarpa kanter förstås sådana oregelbundenheter som känns skarpa eller spetsiga vid beröring med bar hand.

5.2 Ingen kantbrytning.

5 Sharp edges after punching and cutting

5.1 Light chamfering
For example chamfering is done with file or manual grinder, which with light pressure is moved once or twice over the edge.
New sharp edges must not arise.
Normally, only the clearing side of a hole or edge are treated.
With sharp edges are understood such irregularities as feel sharp or pointed when touched with bare hand.

5.2 No chamfering.

6 Skarpa kanter efter bränning

6.1 Slaggrester avlägsnas.
Slagg förutsatts vara avlägsnat i samband med bränning.

6.2 Spetsiga toppar på snittytan jämnas.
Kommentar lika 3.6.

6.3 Lätt kantbrytning.
Kommentar lika 5.1.

6.4 Ingen kantbrytning.

6 Sharp edges after flame cutting

6.1 Slag to be removed.
It is implied slag to be removed in connection with flame cutting.

6.2 Sharp peaks on section surface to be smoothed.
Comments the same as in 3.6.

6.3 Light chamfering.
Comments the same as in 5.1.

6.4 No chamfering.

7 Defekter i stålyta

7.1 Synliga ytfel, vassa kanter och grader vid intryckningar nedslipas.

Ytfel såsom flagor, brännsår m m ifylls efter nedslipningen med svets endast i de fall då godstjockleken nedsätts väsentligt eller då klassificeringssällskapet så kräver. Se även VIS 530, Kvalitet och noggrannhet vid fartygsbyggnad, punkt 15. I övrigt utförs nedslipningen så att mjuka övergångar erhålls. Skulle ifyllning vara nödvändig för färgens filmbildning, kan detta utföras med spackelmaterial av passande typ. Detta anges då särskilt. Beträffande skarpa kanter etc jämför 3.6 och 5.1.

7.2 Brännsår bortsmärglas.

7.3 Mjuka runda defekter åtgärdas ej.

7.4 Defekter i stålytan åtgärdas ej.

8 Skadad Shopprimer och icke shopprimerbehandlad yta

8.1 Blästring enligt 1.

8.2 St 3. Enligt SIS 05 59 00 - 1967.

8.3 St 2. Enligt SIS 05 59 00 - 1967.

8.4 Lätt stålborstning.
Kommentar se 3.5.

9 Bättring av shopprimerbehandlad yta

Skall utföras efter det att ytan rengjorts och innan återrostning sker.

9.1 Bättring med primer enligt anvisning.

9.2 Ingen bättring.

10 Rengöring av shopprimerbehandlad yta

Typ och beteckning av rengöringsmedel anges vid beställning.

10.1 Svepblästring.

Svepblästring innebär en rengöring som utförs i stället för tvättning och i samband med fristråleblästring av svetsar och skadad shopprimer. Efter svepblästring skall ytan efter avdamning övermålas innan återrostning sker.

10.2 Avfettning.

Fett och olja avlägsnas med lämpligt fettlösande medel, exempelvis kristallolja jämte emulgator. Om ytan tvättas skall denna torka väl före målning.

10.3 Annan rengöring.

Andra föroreningarna än fett och olja ex svetsrök borttages enligt anvisning. Om ytan tvättas skall denna torka väl före målning.

10.4 Damning.

Sopning, dammsugning, tryckluftsblåsning o dyl.

10.5 Ingen rengöring.

7 Defects in steel surface

7.1 Visible surface defects, sharp edges and burrs at indents to be ground.

Surface defects, such as flakes, burnt areas etc. to be filled with weld after grinding only when the steel thickness is substantially reduced or if required by the classification society. See also VIS 530, Ship building quality and accuracy, point 15. Otherwise the grinding is carried out so that smooth passages are obtained. Should filling out be necessary for the forming of the paint film, this can be done with putty of suitable type. This to be specially stated. Concerning sharp edges etc. see 3.6 and 5.1.

7.2 Burnt areas to be ground.

7.3 Smooth round defects not to be treated.

7.4 Defects in the steel surface not to be treated.

8 Damaged shop primer and surface not treated with shop primer

8.1 Blasting according to 1.

8.2 St 3. according to SIS 05 59 00 -1967.

8.3 St 2. according to SIS 05 59 00 -1967.

8.4 Light wire-brushing.
Comments, see 3.5.

9 Touching up of shop primed surface

Shall be carried out after cleaning of surface and before re-rusting.

9.1 Touching up with primer in accordance with directions.

9.2 No touching up.

10 Cleaning of shop primer treated surface

Type and designation of detergent to be stated on the order.

10.1 Sweep blasting.

Sweep blasting implies a cleaning that is carried out instead of washing and in connection with air blasting of welds and damaged shop primer. After sweep blasting, the surface shall be dusted off and painted, before re-rusting.

10.2 Degreasing.

Grease and oil to be removed by suitable grease dissolving medium, for example white spirit with emulsifier. If the surface is washed it has to be dry before painting.

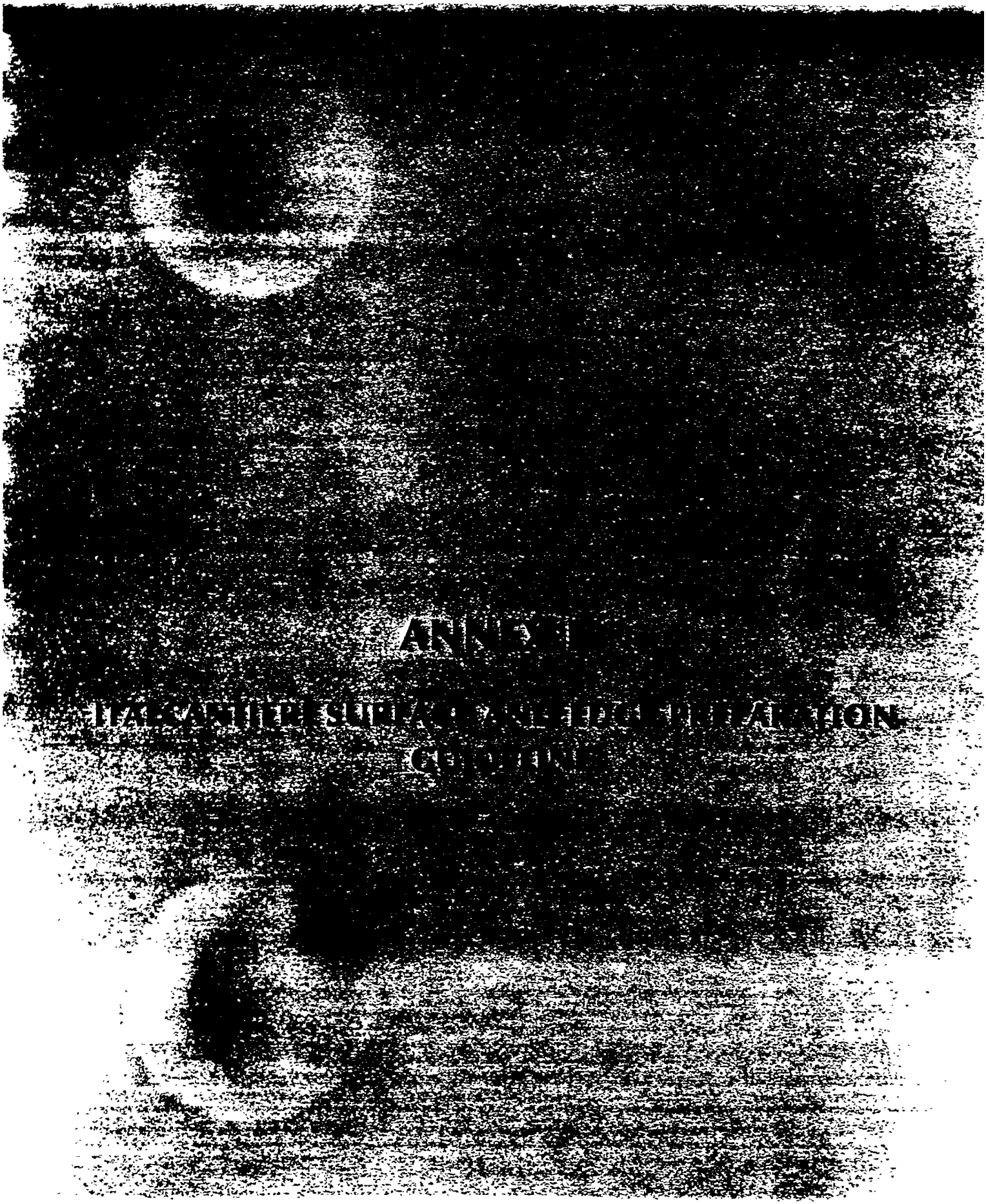
10.3 Other type of cleaning.

Other impurities than grease and oil, for example weld smoke, to be removed in accordance with directions. If the surface is washed it has to be dry before painting.

10.4 Dusting.

Sweeping, vacuum cleaning, air blowing etc.

10.5 No cleaning.



ANNEX E

ITALCANTIERI SURFACE AND EDGE PREPRATION

ITALCANTIERI - SETTORE TECNICO				DIS.NORMALE PL90113 A	
DATA	NOME	FIRMA	SCALA	TITOLO	
3.1979	Casani			LAVORAZIONI ED INTERVENTI DI PREPARAZIONE SU BLOCCHI E STRUTTURE IN GENERE PER CISTERNE DA CARICO (ESCLUSO CRUDE OIL CARRIERS)	
	Bonini				
Ing.	Naultan				FOGLIO NO. 1/3

1. SCOPO ED USO

1.1 Dotare gli esecutori ed i controllori della preparazione dell'acciaio di una serie di visualizzazioni schematiche dei casi maggiormente rappresentativi di superfici non compatibili con il ciclo di pitturazione cisterne da carico atte a contenere prodotti petroliferi raffinati e/o olii vegetali.

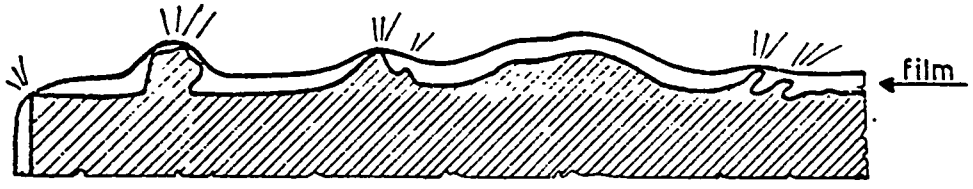
1.2 AVVERTENZA : Il procedimento di pitturazione delle cisterne adibite a tale uso comporta il rispetto di norme e restrizioni che devono essere assolutamente osservate e la loro applicazione assoggettata ad un controllo continuo.

2. GENERALITA'

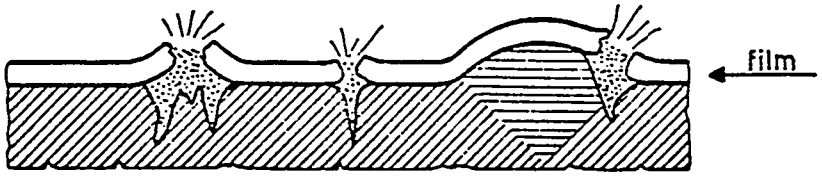
2.1 Prima della preparazione specifica (generalmente sabbiatura) delle superfici per l'applicazione del ciclo di pitturazione cisterne del carico, ogni e qualunque superficie a spigolo vivo o danneggiata dovrà essere resa idonea a ricevere il trattamento protettivo.

2.2 Onde stabilire un criterio standard d'intervento, i difetti di lavorazione ed i danneggiamenti si possono suddividere in due categorie:

A - Spigoli e protuberanze, quando si presentano per forma e/o dimensioni tali da compromettere la continuità di spessore del film di pittura



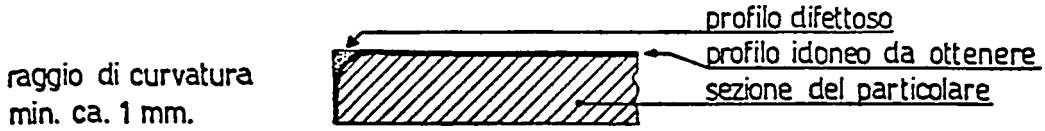
B - Crateri, quando le cavità possono diventare deposito di ruggine, aria umida ed altre sostanze contaminanti per il film di pittura



) Marzo 1979 - aggiornato
04.0276.02 ARD Mult. 1.71

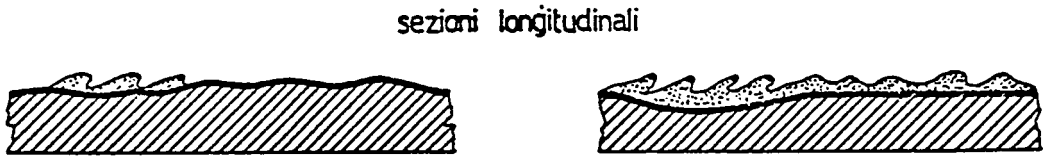
3. INTERVENTI SU DIFETTI DI TIPO "A"

A1 - Intervento di molatura su spigoli vivi

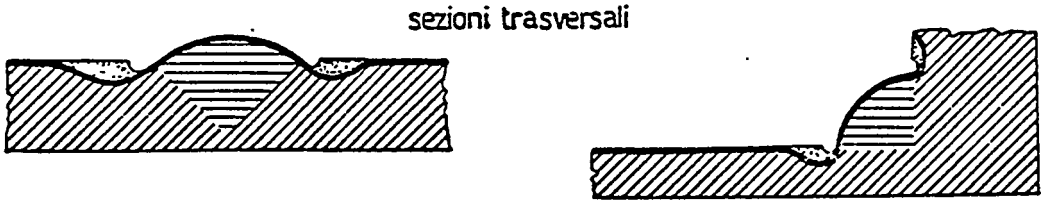


A2 - Intervento di molatura su spruzzi di saldatura e tracce di lavorazione (es. eliminazione occhi sospendita).

A3 - Intervento di molatura su striature di tagli ossiacetilenici

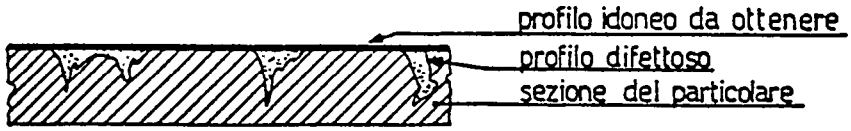


A4 - Intervento di molatura su incisioni longitudinali di saldature



4. INTERVENTI SU DIFETTI DI TIPO "B"

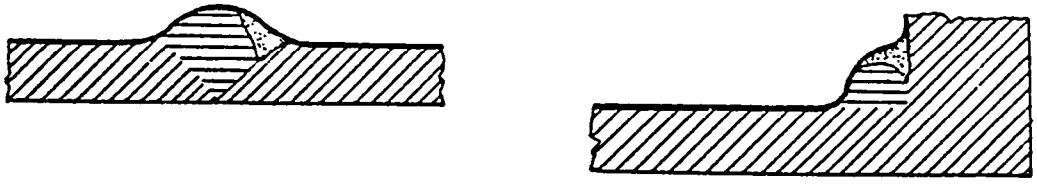
B1 - Interventi di riempimento e molatura su incisioni profonde



B2 - Interventi di riempimento e molatura su difetti di saldature. Nessun intervento su microporosità.

B3 - Interventi di riempimento e molatura su crateri

sezioni longitudinali



sezioni trasversali

ANNEX F

SUMMARY OF FRENCH STANDARD IRCN

STANDARD IRCN

POUR PRÉPARATION DES ARÊTES VIVES

		PT(1)	PT(2)	PT(3)	PT(4)
Arêtes créées par le poinçonnage (ébavurage par meulage à plat + grenaillage + ECOL ZINC)		Néant	Néant	angle fraisé sans chanfrein	meulage en arrondi au lapidaire ou à la meule carotte (R=2mm)
Arêtes créées par oxycoupage automatique	grenaillage + ECOL ZINC	Néant	Néant	angle fraisé sans chanfrein	meulage en arrondi au lapidaire ou à la meule carotte (R=2mm)
	Brutes d'oxycoupage	grattage du laitier et des scories non adhérentes	meulage au lapidaire avec chanfrein à 45° de 1 à 2mm Présence d'1 ou 2 fils tranchants dus au meulage	angle fraisé sans chanfrein	meulage en arrondi au lapidaire ou à la meule carotte (R=2mm)
Arêtes créées par oxycoupage manuel		grattage du laitier et des scories non adhérentes	meulage au lapidaire avec chanfrein à 45° de 1 à 2mm présence d'1 ou 2 fils tranchants dus au meulage	angle fraisé sans chanfrein	meulage en arrondi au lapidaire ou à la meule carotte (R=2mm)

STANDARD IRCN

for the preparation of sharp edges

		PT (1)	PT (2)	PT (3)	PT (4)
Edges obtained by shearing (dressing by grinding + blasting + zinc coating)		None	None	Angles ground without bevel	Round edges by disc grinding R = 2 mm
Edges obtained by automatic oxygen torch cutting	blasting + zinc coating	None	None	"	"
	Rough cut with oxygen (as cut)	Scraping the slag and the non-adhering dross	Disc grinding with a chamfer of 1 to 2 mm at 45° angle. Presence of 1 or 2 edges due to grinding	"	"
Edges obtained by manual oxygen torch cutting		"	"	"	"

Note: unofficial translation.

ANNEX G

TANK COATING SPECIFICATIONS FOR PRODUCT CARRIERS

(The Shipbuilders' Association of Japan)

QUALITY AND INSPECTION STANDARD OF DE-RUSTING

TANK COATING SPECIFICATIONS FOR PRODUCT CARRIERS

APRIL 1982

THE SHIPBUILDERS' ASSOCIATION OF JAPAN

TANK COATING SPECIFICATIONS FOR PRODUCT CARRIERS

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EXPLANATIONS . . . . . - 13-28

1. Purpose

Standards concerning the coating process and inspection were prepared by The Shipbuilders' Association of Japan in order to achieve optimum film characteristics when coating is done iniside the tank of a product carrier. These standards are based on the painting process and inspection methods which are standard practice in most Japanese shipyards.

These standards were prepared in accordance with the agreements between the Sub-committee on Special Coating, The Shipbuilders' Association of Japan and the sub-committee on Marine Paint, Japan Paint Industry Association.

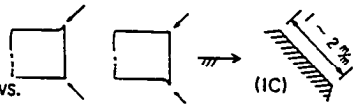
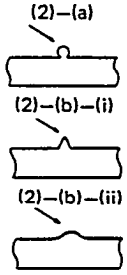
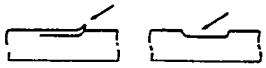
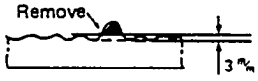
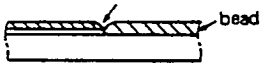
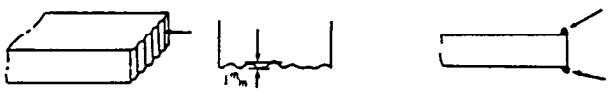
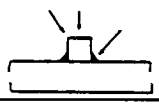
II. Prerequisites

No.	Item	Prerequisites	Remarks
①	Type of vessel	30,000-40,000 DWT type with SBT (Segregated Ballast Tank).	Refer to explanation.
②	Tank coating area	Approx. 40,000-60,000 m².	
③	Type of cargo	Petroleum products (white and black); chemical products are not principal object.	Refer to explanation.
④	Cargo temperature	Max. heating temperature: 70"C.	Refer to explanation.
⑤	Inert gas system	Equipped.	
⑥	Tank cleaning	According to the paint manufacturer's recommendation.	
⑦	Tank anode	Not provided.	Refer to explanation.
⑧	Heating coil	Equipped. Materials may be either aluminium brass or stainless steel.	
⑨	Outfittings	In case of steel, painting is similar to the tank proper. In case of stainless steel, aluminium brass, and galvanized steel, in principle, no painting is done.	
⑩	Paint to be used	Three coats of pure epoxy paint.	
⑪	Dry film thickness	Total 250 microns.	Refer to explanation.
⑫	Shop primer	For steel materials in the tank, inorganic zinc type shop primer is applied after shot blasting.	
⑬	Holding primer	May be used.	
⑭	Painting process	Afloat painting.	Refer to explanation.
⑮	Film curing period before loading	Water ballast or cargo must not be loaded during the film curing period as recommended by the paint manufacturer.	
⑯	Guarantee	One year guarantee is provided, within the conditions for film defect liability insurance as stated in the shipbuilding contract.	
⑰	Insurance	Film defect liability insurance	

III. Coating Process Standards

III-1. Preparation Standards for Steel

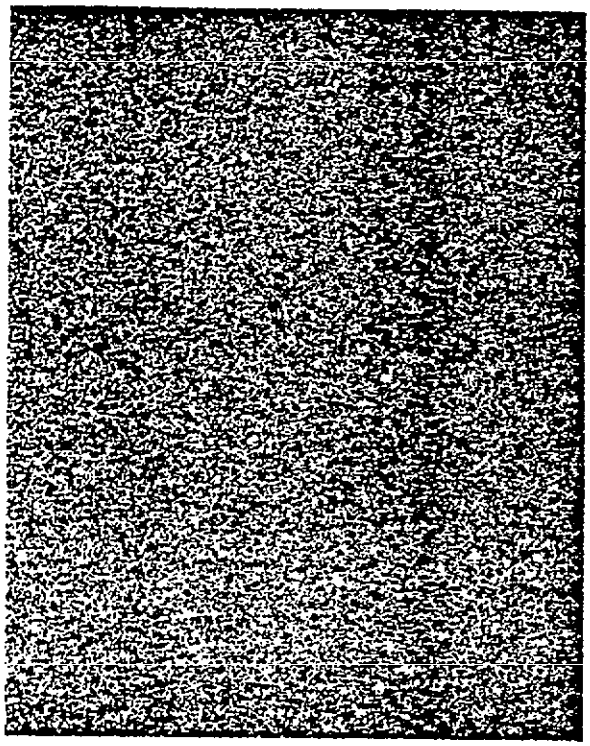
This standard applies to hull structures and principal outfittings such as cargo oil hatches, external surfaces of cargo oil pipes, etc.

No.	Item	Process standard	Judgement	Remarks
⑱	**Free edge**	(1) Remove sharp edges or plate burr caused by gas cutting with a grinder or disc sander as the diagram shows.  (2) As a rule, rolled angle edges (including flat bars) are to be left untreated.	Visual	
⑲	**Spatter**	(1) Remove spatter observed before blasting with a grinder, chipping hammer, etc. (2) For spatter observed after blasting: (a) Remove with a chipping hammer, scraper, etc. (b) For spatter not easily removable with a chipping hammer, scraper, etc. (i) Sharp angle spatter – Apply grinder or disc sander till the angle becomes obtuse. (ii) Obtuse angle spatter – Not to be treated. 	Visual	
⑳	**Undercut**	Undercut to a depth exceeding 0.8 m/m and a width smaller than the depth, to be repaired by welding or grinding. 	Visual	Refer to JSQS-1979 (Hull part), "Undercut" (Refer to explanation.)
㉑	**Surface damage**	Surface damage, pitting, break-off marks, to a depth exceeding 0.8 m/m. to be repaired by welding or grinding. 	Visual	Refer to JSQS-1979 (Hull part), "Surface flaw". (Refer to explanation.)
㉒	**Manual welding bead**	For a bead with surface irregularity exceeding 3 m/m or with a sharp crest, apply the grinder until the irregularity less than 3 m/m. 	Visual	Refer to Steel Ship Construction Method, vol. VII, 6, 4, 2 "Weld appearance inspection standard", (3) Control Standards. (Refer to explanation.)
㉓	**Automatic welding bead**	As a rule, no specific treatment is made.	Visual	
㉔	**Overlap welding bead**	Overlap welding bead with sharp notch to be repaired as per item ㉑, "Undercut". 	Visual	Refer to Steel Ship Construction Method vol. VII, 6, 4, 2 "Weld appearance inspection standard", (2) Inspection standards. (Refer to explanation.)
㉕	**Welding arc strike**	Apply item ⑲, "Spatter", and item ㉑, "Surface damage".	Visual	
㉖	**Gas cut surface**	Gas cut surfaces to be treated by grinding, as follows. (a) Except for areas which must be finished smoothly from the standpoint of hull strength, the grinder is applied to reduce irregularity of a notch to below 1 m/m. (b) Gas slag produced during cutting, to be treated according to item ⑱, "Free edge", before blasting. 	Visual	Refer to JSQS-1979 (Hull part), "Gas notch". (Refer to explanation.)
㉗	**Lifting piece**	Except for permanent pieces, cut section of lifting piece and the surrounding area to be treated according to item ⑱, "Free edge", item ㉕, "Manual welding bead", and item ㉖, "Gas cut surface". 	Visual	

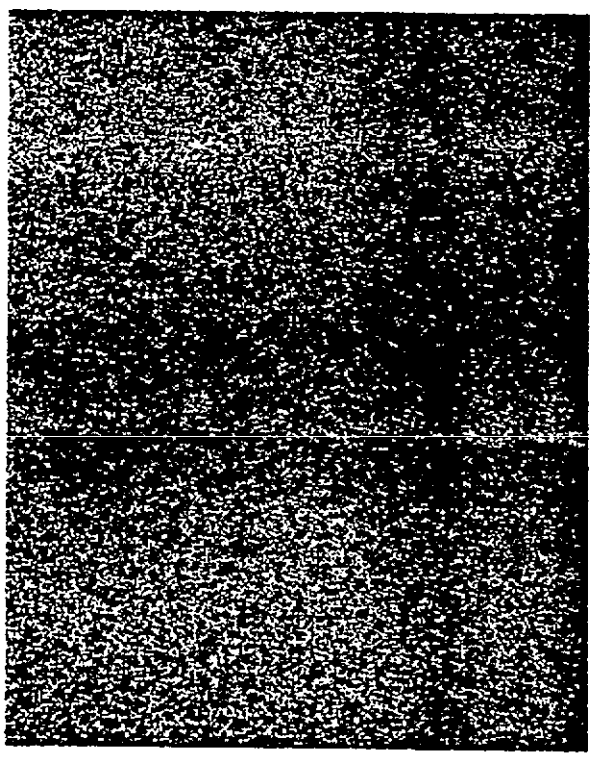
III-2. Secondary Surface Preparation Standards

No.	Item	Process standard	Judgement	Remarks
㉘	**Blast cleaning of sound shop primer surface**	The entire sound shop primer surface to be blasted to the cleanliness as photographic standard No. 1.	Comparison using photographic standard	Refer to photographic standard No. 1 (p.6) Refer to explanation.
㉙	**Blast cleaning of welding bead**	The welding bead and the surrounding area to be blasted to the cleanliness as photographic standard No. 2	Comparison using photographic standard	Refer to photographic standard No. 2 (p.6) Refer to explanation.
㉚	**Blast cleaning of burnt area**	Burnt area to be blasted to the cleanliness as photographic standard No. 3.	Comparison using photographic standard	Refer to photographic standard No. 3 (p.7) Refer to explanation.
㉛	**Blast cleaning of rusted area**	Rusted area to be blasted to the cleanliness as photographic standard No. 4.	Comparison using photographic standard	Refer to photographic standard No. 4 (p.7) Refer to explanation.
㉜	**Abrasives**	The type and size of abrasives to be in accordance with the standards of the shipyard.	———	Refer to explanation.
㉝	**Repair of insufficiently blasted area**	Minor repair after blasting to be carried out with power tools.	Visual	Refer to explanation.

Photographic Standards for Secondary Surface Preparation

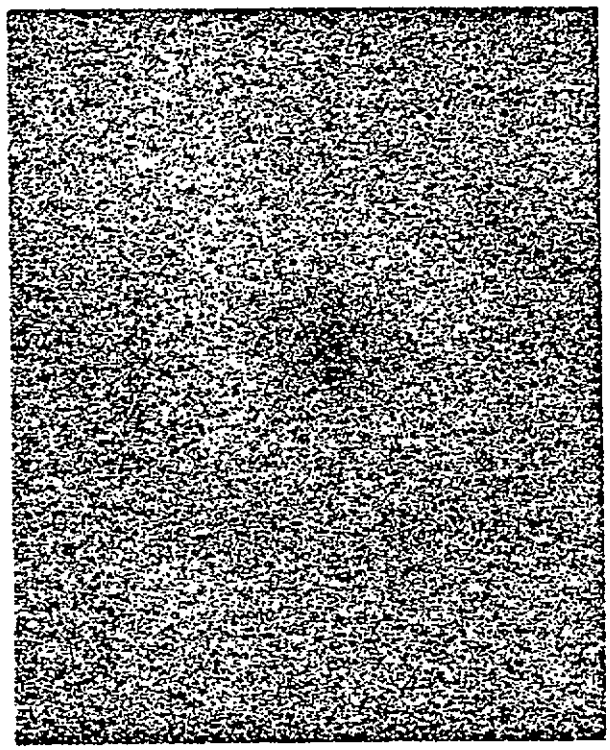


No. 1 Blast cleaning of sound shop primer surface

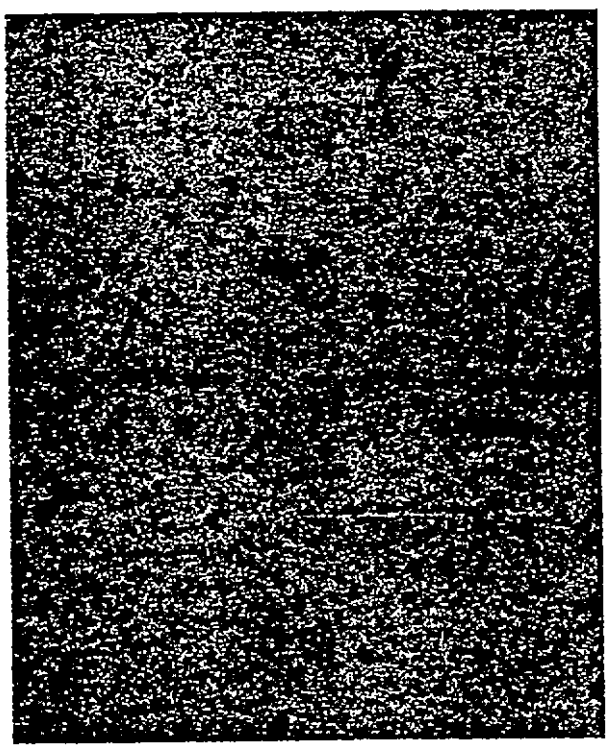


No. 2 Blast cleaning of welding bead

No. 3 Blast cleaning of burnt area



No. 4 Blast cleaning of rusted area



III-3. Process Standards

III-3-(1) Cleaning Standards Before Coating

No.	Item	Process standard	Judgement	Remarks
㉞	**Moisture**	To be removed until no visible moisture remains.	Visual	Refer to explanation.
㉟	**Oil and grease contaminants**	To be removed. Trace of wiping with thinner is permitted.	Visual	Refer to explanation.
㊱	**Dust and mud contaminants**	To be removed. Dust or mud contaminants to be removed with a rag, broom, or vacuum cleaner.	Visual	Refer to explanation.
㊲	**Chalk or slate pencil marks**	To be removed. After removal with rag or brush, the trace may be visible.	Visual	Refer to explanation.
㊳	**Marking paint**	To be removed. After removal with blasting or power tools, the trace may be visible. Marking paint for epoxy need not be removed.	Visual	

III-3-(2) Coating Standards

No.	Item	Process standard	Judgement	Remarks
㊴	**Stripe coating**	Before the overall coating, stripe coating to be applied to the following locations, in order not to leave portions unpainted. (a) Inside and edges of holes (b) Free edges (c) Manual welding beads (d) Where airless spraying is not applicable	Visual	Refer to explanation.
㊵	**Overall coating**	Airless spraying to be applied, taking care not to leave portions unpainted and insufficient film thickness.	Wet gauge and visual	

III-3-(3) Repair Coating Standards

No.	Item	Process standard	Judgement	Remarks
㊶	"Sagging"	"Sagging" with the height of 1 m/m and more, and wide "sagging" to be repaired.	Visual	Refer to explanation.
㊷	Spray dust	Remarkable spray dust to be removed before painting. Spray dust may be removed with a scraper, sand paper, or plastic brush.	Visual	
㊸	Foreign matters	Foreign matters in the paint film to be removed and damaged film to be repainted.	Visual	Refer to explanation.
㊹	Craters, pinholes, and bubbles	Remarkable defects to be repaired.	Visual	Refer to explanation.
㊺	"Blushing"	Remarkable "blushing" on the film surface to be repaired except final coating film.	Visual	Refer to explanation.
㊻	Mechanical damage	Damaged film to be removed and repaired by tapering the boundary of the sound film.	Visual	Refer to explanation.
㊼	Insufficient film thickness	Areas with insufficient film thickness to be repaired. Portions which have passed the specified painting interval to be abraded before repainting.	Visual	

III-3-(4) Film Thickness Measurement Standards

No.	Item	Process standard	Judgement	Remarks
㊽	Film thickness measurement of plate	Film thickness to be measured each 5 m^2 for flat panels. Film thickness to be measured at two points per section surrounded by transverses and longitudinals or girders.	Micro tester or electro-magnetic film thickness gauge	Refer to explanation.
㊾	Film thickness measurement of longitudinal members	Film thickness to be measured at two points between transverse members for each side of web and face plates.	Micro tester or electro-magnetic film thickness gauge	
㊿	Film thickness measurement of transverse members	Film thickness to be measured at three points between longitudinal girders or bulkhead for each side of web and face plates.	Micro tester or electro-magnetic film thickness gauge	

Ⅲ-4. Environmental Painting Standards

No.	Item	Process standard	Judgement	Remarks
⑤①	**Temperature (During blasting, painting, and drying)**	Temperature in tank to be kept above 5°C.	Measure with a thermometer.	Refer to explanation.
⑤②	**Humidity (During blasting, painting, and initial drying)**	Relative humidity in tank to be below 85%. Or the surface temperature to be kept more than 3°C above the dew point.	Measure with a hygrometer. Measure with a surface thermometer	Refer to explanation.
⑤③	**Ventilation (Immediately before blasting to painting)**	Air change rate to be two times per hour, or more and effective ventilation to be considered.	Check the ventilating installations.	Refer to explanation.
⑤④	**Ventilation (During painting and drying)**	Air change rate to be five times per hour or more. If the external air humidity is above 85%, air change rate may be decreased according to the capacity of dehumidifier.	Check the ventilating installations.	Refer to explanation.
⑤⑤	**Erection of scaffoldings**	To make sure that scaffolding does not interfere with painting, ventilation, illumination, blasting, and inspection.	Visual	Refer to explanation.
⑤⑥	**Removal of scaffoldings**	To take care not to damage the film.	Visual	
⑤⑦	**Illumination**	Effective illumination to be considered.	Visual	Refer to explanation

III-5. Inspection and Control

III-5-(1) Inspection

No.	Item	Inspection standard	Inspector and witness		
			Owner	Shipyard	Paint manu-facturer
⑱	Treatment of steel surface	According to III-1, Preparation Standards for Steel	○	○	○
⑲	Secondary surface preparations	According to III-2, Secondary Surface Preparation Standards	○	○	○
⑳	Stripe coating	According to III-3-(2), Coating Standards		○	○
㉑	Film thickness	According to III-3-(4), Film Thickness Measurement Standards		○	○
㉒	Final inspection	Final confirmation of completion of painting	○	○	○

III-5-(2) Control

No.	Item	Control standard	Control		
			Owner	Shipyard	Paint manu-facturer
㉓	Temperature, humidity, and dew point	According to III-4, Environmental Painting Standards		○	○
㉔	Gas concentration of solvent	According to "The Safety and Health Standards for Painting" (Refer to explanation).		○	○
㉕	Ventilation	According to III-4, Environmental Painting Standards		○	○

EXPLANATIONS

EXPLANATIONS

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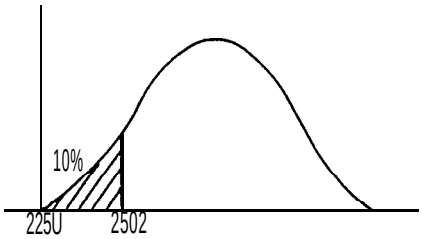
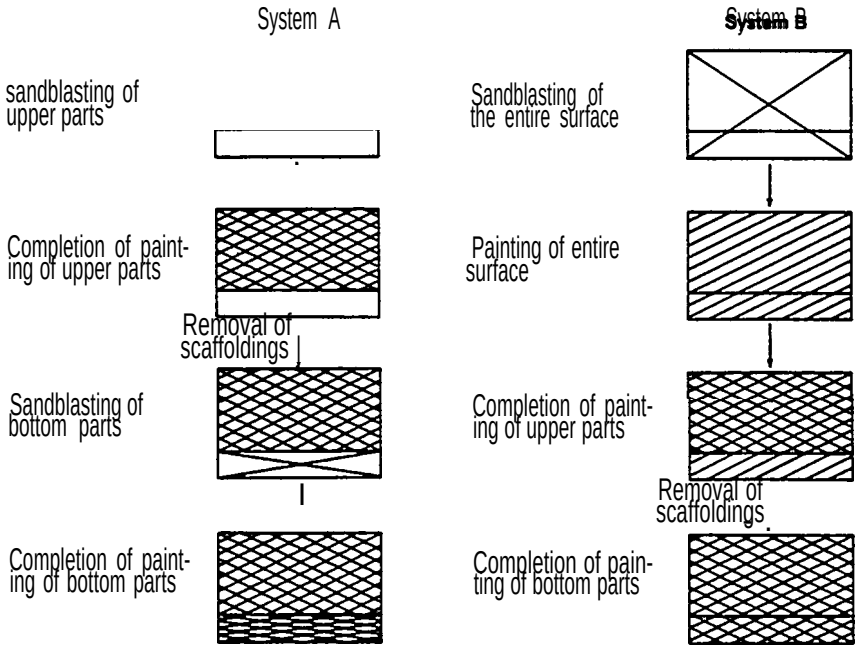
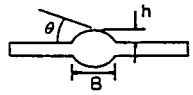
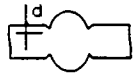
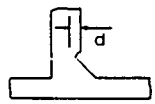
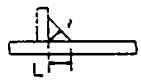
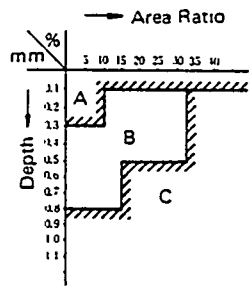
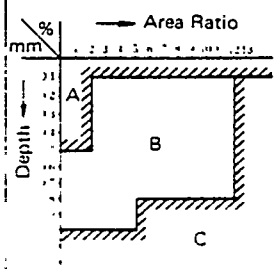
(55) Erection of scaffoldings 2
(57) Illumination 2

Note: Above item Nos. are the same as these of **"Tank Coating Specifications for Product Carriers".**

II. Prerequisites

No.	Item	Explanation
①	Type of vessel	The prerequisites specify a 30,000 to 40,000 DWT type. This standard may also be applied to larger vessels.
③	Type of cargo	Principally heavy oil, kerosene, light oil, diesel oil, naphtha, and gasoline are considered. If the condition allows, solvents such as benzene, toluene, xylene may also be included.
④	Cargo temperature	Temperature to be max. 70°C. Howaver, a max. of 75°C is allowed if the cargo moisture content is extremely low and the loaded period is short.
⑦	Tank anode	(1) Anodes may be installed for tanks (slop tanks, etc.) which are often loaded with sea water. (2) Anodes are Mt to be installed when dissolution of zinc into the cargo presents problems (as in the case of jet fuel, etc.).
⑪	Dry film thickness	Measurement at 90% of total measuring points must verify a film thickness exceeding a specified value (250 micron). For the remaining 10%, the measured film thickness must be over 90% (225 micron) of the specified thickness. 
⑭	Painting process	(1) For tank coating, block painting, painting in a dry dock, afloat painting, or any combination is considered. However this standard is based on afloat painting only. (2) For sandblasting and painting in tank, the following two systems maybe considered: 

III-1. Preparation Standards for Steel

<table>
<tr><th>No.</th><th>Item</th><th>Explanation</th></tr>
<tr><td>⑳</td><td>Undercut</td><td>
(Japanese Shipbuilding Quality Standards (J.S.Q.S.)-1979 (Hull Part) (Refer to Note 1.)
<table>
<tr><th colspan="2">Division</th><th colspan="3">Welding</th></tr>
<tr><th>Section</th><th>Sub-section</th><th>Item</th><th>Tolerance limits</th><th>Remarks</th></tr>
<tr><td rowspan="4">Shape of bead</td><td>Height of reinforcement, Breadth of bead, Frank angle</td><td></td><td> 
h: not defined
B: not defined
θ ≦ 90°</td><td> 
In case where θ is over 90°, it is to be repaired by grinding or welding to make θ ≦ 90°</td></tr>
<tr><td rowspan="2">Under cut (butt weld)</td><td>Skin plate and face plate between 0.6L ⊗</td><td>Over 90mm continuous d ≦ 0.5mm</td><td rowspan="3">  </td><td rowspan="3">to be repaired by using fine electrode.
(carefully avoid short bead for higher tensile steels)</td></tr>
<tr><td>Others</td><td>d ≦ 0.8mm</td></tr>
<tr><td>Under cut (fillet weld)</td><td></td><td> 
d ≦ 0.8mm</td></tr>
<tr><td></td><td>Leg length</td><td>Compared with correct ones (L, ℓ)</td><td> 
L Leg length
ℓ Throat depth
L ≧ 0.9
ℓ ≧ 0.9</td><td>In case where it is over tolerance limits, weld up over it.
(carefully avoid short bead for higher tensile steels)</td></tr>
</table>
</td></tr>
<tr><td>㉑</td><td>Surface damage</td><td>
(Japanese Shipbuilding Quality Standards (J.S.Q.S.)-1979 (Hull Part) (Refer to Note 1.)
<table>
<tr><th colspan="2">Division</th><th colspan="2">Material</th></tr>
<tr><th>Section</th><th>Sub-section</th><th>Item</th><th>Remarks</th></tr>
<tr><td rowspan="2">Surface flaw</td><td>Pit</td><td>Grade of pit
 
</td><td>1. Grade A is to be considered so slight that any repair is unnecessary.
Grade B is of medium disorder and is to be repaired if necessary.
Grade C is remarkable in disorder and neeeds some repair.
2. Boundary lines of grade B are included in grade A or respectively.
3. The area ratio of pit denote D in the abscissa means the percentage of pitted areas where surface appearance is unsatisfactory for practical use.
For skin plate
Percentage of pitted area = Area of pit / Total area of a plate
4. Repair method of surface flaw
Depth of defects : d
Plate thickness : t
d < 0.07t ..... removed by grinding (but in no case d≦3mm)
0.07t ≦ d ≦ 0.2t ····· grinding followed by welding</td></tr>
<tr><td>Flaking</td><td>Grade of surface flaking
 
</td><td>1. Grade A is to be considered so slight that any repair is unnecessary.
Grade B is of medium disorder and is to be repaired if necessary.
Grade C is remarkable in disorder and needs some repair.
2. Boundary lines of grade B are included in grade A or C respectively.
3. Repair method of surface flaw
Depth of defects : d
Plate thickness : t
d < 0.07t ····· removed by grinding (but in no case d≦3mm)
0.07t ≦ d ≦ 0.2t ····· grinding followed by welding</td></tr>
</table>
</td></tr>
</table>

No.	Item	Explanation
㉒	Manual welding bead	The following sentence is quoted and translated from Steal Ship Construction Method, Vol. VII 6,4,2, Inspection Standards for Hull Wald Appearance. (Refer to Note 2) (3) Control Standards (ii) Irregularity of bead surface (a) Control standards concerning irregularity of bead surface 1) Standard range of height of the bead surface irregularity is 2 m/m and below for a bead length of 25 m/m. 2) Except for special cases (i.e. concave fillet), the above standards 1) to be applied to the fillet. 3) When the above height exceeds 3^{m}/m for a bead lengthof25'/m, all beads must be repaired.
㉔	Overlap welding bead	The following sentence is quoted and translated from Steal ship Construction Method, Vol. VII 6,4,2, Inspection Standards for Hull Weld Appearance. (Refer to Note 2.) (2) inspection Standards (iv) Overlaps (a) inspection standards concerning overlaps 1) Inspection Standards (1) The allowable amount of overlap is zero. (2) All overlaps to be repaired.

No.	Item	Explanation
㉖	Gas cut surface	(Japanese Shipbuilding Quality standards (U.S.Q.S.)-1979 (Hull Part) (Refer to Note l.)

Division		Gas Cutting			UNIT : mm or {DegreeJ
Section	sub-sect	Item	Standard range	Tolerance limits	Remarks
Notch	Free edge	1) Upper edge of shear strake. 2) Strength deck between 0.6L ⊗ and free edge of opening of shell plate. 3) Main longl strength member.		Indentation <=0	In case where It is rseces-sary to be smoothly finished by grinder. It is to be welded uo. (carefully avoid short bead)
		Longitudinal and Trans-verse strength members.		Indentation <=1	
		Others		Indentation <=3	
	Weld groove	Butt Weld: Shell plate and Upper-deck between 0.6L ⊗		Indentation <=2	Notch is to be repaired by grinder or gouging. (CarefullY avoid weld defects)
		Butt Weld: Others		Indentation <=3	
		Fillet Weld		Indentation <=3	
	An indentation is defined as the notch. in case where its depth is more than 3 times the tolerance limits of roughness.				

Notes:

1. Japanese Shipbuilding Quality Standards (J.S.Q.S.)-1979 (Hull Part) by Research Committee on Steel Shipbuilding, The Society of Naval Architects of Japan.

2. Steel Ship Construction Method, VOI-VII by Research Committee on Steel Shipbuilding, The Society of Naval Architects of Japan.

III -2. Secondary Surface Preparation Standards

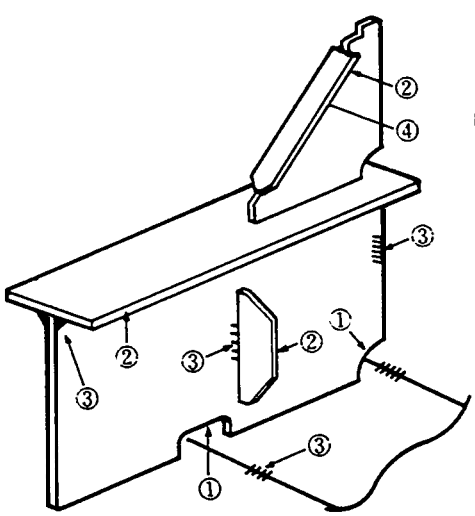
No.	Item	Explanation
㉘	**Blast cleaning of sound shop primer surface**	(1) In general, the color of the shop primer is to be either green or gray. Photographic standard No. 1 uses green. (2) Photographic standard No. 1 shows blast cleaning using granulated copper slag, which achieves a shop primer removal ratio of about 70%. (Photographic standards Nos. 2-4 which also show blast cleaning, using granulated copper slag.)
㉙	**Blast cleaning of welding bead**	Photographic standard No. 2 shows blast cleaning up to the cleanliness as SIS-C-Sa 2.5 .
㉚	**Blast cleaning of burnt area**	Photographic standard No. 3 shows blast cleaning up to the cleanliness as SIS-C-Sa 2.5 .
㉛	**Blast cleaning of rusted area**	Photographic standard No. 4 shows blast cleaning up to the cleanliness as SIS-C-Sa 2.5 .
㉜	**Abrasives**	(1) As abrasives, copper slag, steel grit, white pig grit, etc. are generally used. (2) Blasted surface color tends to vary depending on the abrasive material used. As long as the same grade of cleanliness is used, a difference in color does not affect the film performance.
㉝	**Repair of insufficiently blasted area**	The "minor repair" area includes: * Local portions with a size of up to 0.5m^2 in flat area. * Intermittent portions on the welding bead.

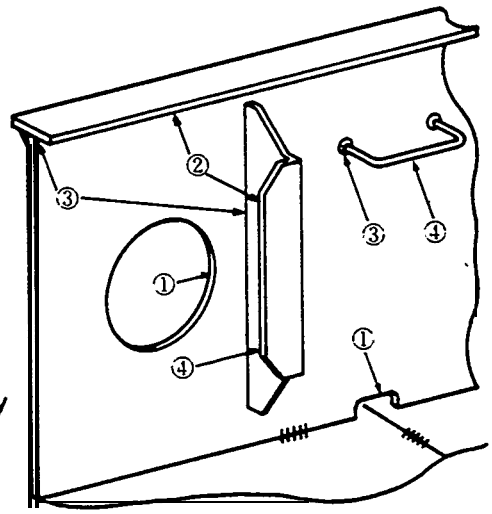
III -3-(1) Cleaning Standards Before Coating

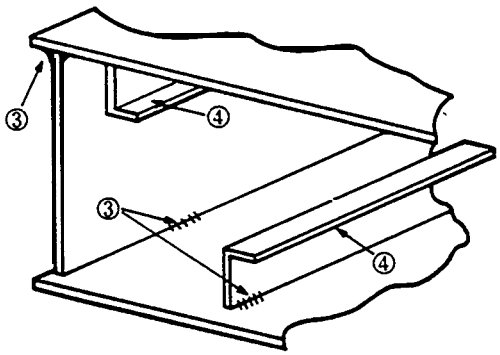
No,	Item	Explanation
㉞	Moisture	Rainwater inflow, the sweat of workers, and moisture in the air may produce sweat on steel surface. After secondary surface preparation, moisture may cause turning or hinder adhesion. To prevent rainwater from flowing in, appropriate measures must be taken with the manhole. Remove moisture with dry air, a mop or rag until no longer visible.
㉟	Oil and grease contaminants	In general, remove with a rag and thinner. For heavy adhesion of grease and oil, first dissolve it with a brush soaked in thinner, then wipe it off with a clean rag.
㊱	Dust and mud contaminants	To prevent mud contaminants from being brought into the tank, it is necessary to have a mat at the entrance of tank, or to have workers wear shoe covers. Remove dust with a rag, broom, or vacuum cleaner.
㊲	Chalk or slate pencil marks	Remove with a rag or brush. When they enter an anchor-patterned concave and are difficult to remove, use a hard brush.

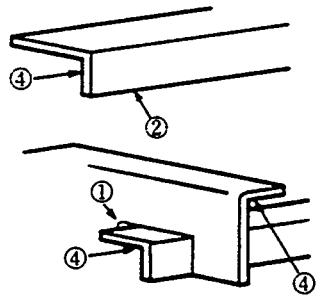
III -3 -(2) Coating Standards

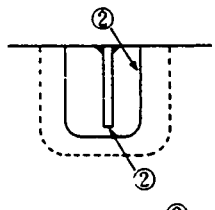
No.	Item	Explanation
㊴	**Stripe coating**	Where airless spraying is difficult and the film thickness can not be kept well, apply stripe coating with a brush before or after the spraying. Stripe coating applied locations are as follows: (a) Inside and edges of holes. . . . . ① (b) Free edges . . . . . ② (c) Manual welding beads. . . . . ③ (d) Where painting is difficult. . . . ④

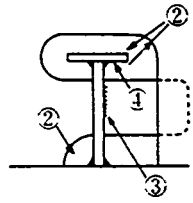




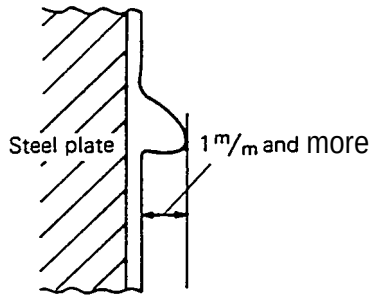
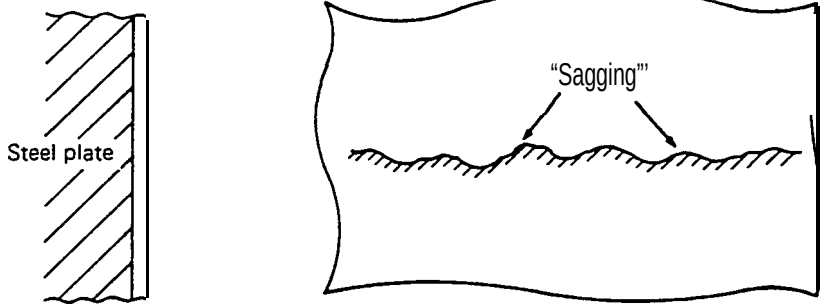
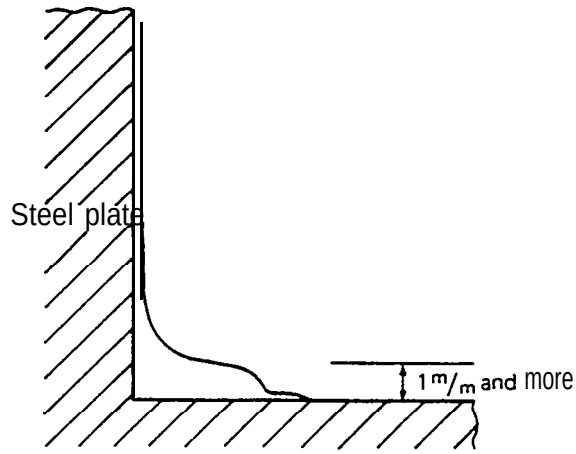


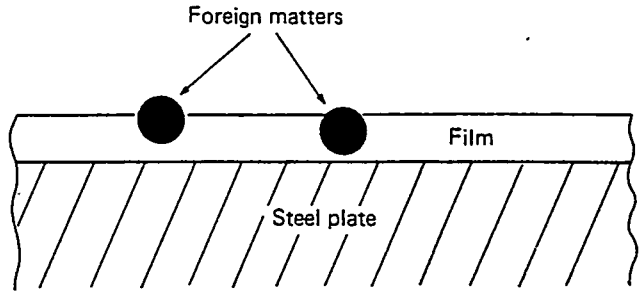
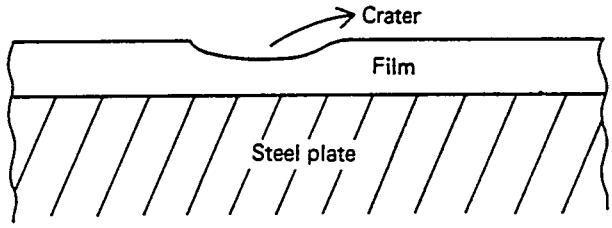
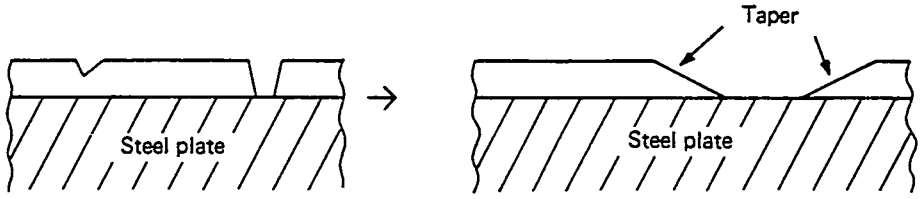




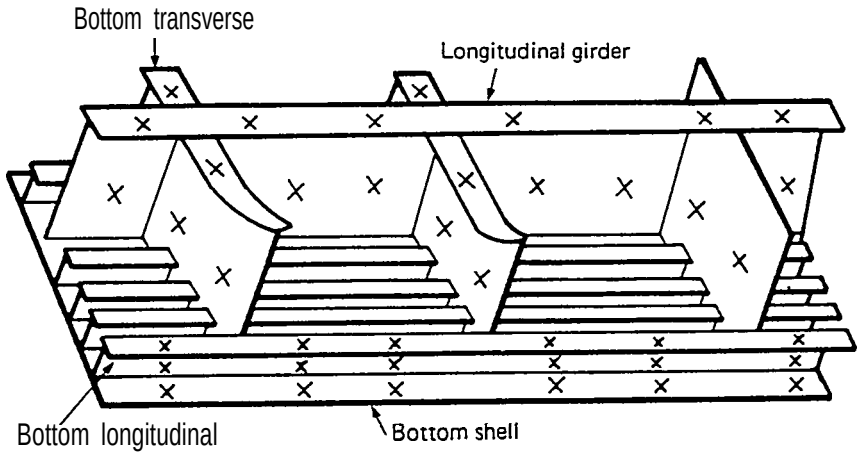
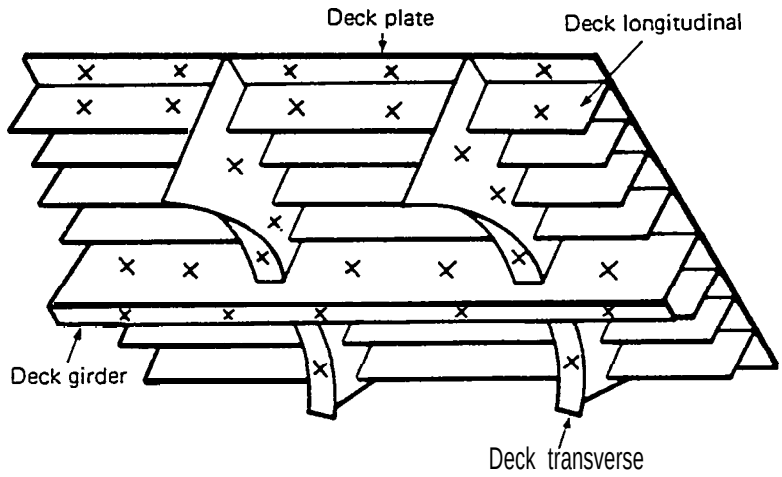


III-3-(3) Repair Coating Standards

No.	item	Explanation
㊶	"Sagging"	The “sagging” of the film needs repair due to the followinq causes: (1) Spray dust, dust, etc. tend to remain on it. (2) In"sagging" portions with a large film thickness, solvent tends to remain. If coating is applied over the “sagging” point, the solvent becomes more evaporate and makes cracks in the film. “Sagging” to be repaired is as follows: (a) “sagging” with the height of 1m/m and more  (b) Wide "sagging"  (c) “Sagging”in the bottom corners 

No.	Item	Explanation
㊸	**Foreign matters**	When abrasives are used in secondary surface preparations (blasting), abrasives remaining in the tank may adhere to paint surface and be trapped in the film during painting.  Foreign matters must be removed because they cause rusting.
㊹	**Craters, pinholes, and bubbles**	(1) Pinholes tend to occur at the pit of manual welding bead. (2) Craters tend to occur when surface tension becomes uneven during the film drying process. A crater is a concave, and reduces film thickness.  (3) Bubbles occur when paint mixed with air is applied in the airless painting.
㊺	**"Blushing"**	The film will become "blushing", due to humidity absorbed by hardening agents. When humidity rises or dew is produced before curing, this may occur. Blushing is confined to the film surface and does not affect the film performance. However, excessive blushing must be repaired because it hinders adhesion of overcoating.
㊻	**Mechanical damage**	

III -3-(4 Film Thickness Measurement Standards

No.	Item	Explanation
㊽ ㊾ ㊿	Film thickness measurement	(1) Measuring equipment to readjusted once a day by using a eference plate with a thlckness nearest to the film thickness to be measured. (2) The measured value of film [sickness to be marked at a measuring point using a specified marking material. Film thickness measuring point (x mark) (a) Bottom part  (b) Deck part 

III-4. Environmental Painting Standards

No.	Item	Explanation
⑤①	**Temperature (During blasting, painting, and drying)**	(1) Lowest temperature (a) Standard temperature in tank — Theoretically the steel plate surface temperature is used. However the air temperature in tank is practically used here. (b) Standard temperature above 5°C — Curing of epoxy resin slows down when the temperature drops below 10°C and 5°C is the lowest limit. It is preferable to keep the temperature above 10°C. (2) Highest temperature The highest acceptable temperature is not specified here as it is difficult to determine. The temperature can also be controlled according to the type of paint used and painting process. To ensure painting efficiency, however, the temperature is to be kept below 30°C during painting and drying.
⑤②	**Humidity (During blasting, painting, and initial drying)**	Relative humidity is to be at or below 85%. This value applies when the painted surface temperature is equal to or above the atmospheric temperature. Even when humidity is below 85%, dew may form. Therefore, it is preferable to maintain the painted surface temperature more than 3°C above the dew point.
⑤③ ⑤④	**Ventilation**	(1) Reasons for different air change rate between blasting and painting; (a) The film begins hardening with evaporation of solvents in the film. (b) Solvent evaporation is greatly influenced by ventilation and temperature. (c) .Residue of solvents affects film performance. Because of the above reasons, the amount of ventilation is larger during painting and drying. (2) Air change rate This standard is determined by the experimental figures so as to get correct film performance, though this varies depending on tank capacity. These standards are different from The Safety and Health Standards for Painting. (Refer to item " ⑤④ ⑥④ " on page 27) (continued)

No.	Item	Explanation
⑬ ⑭	Ventilation	(3) Air change rate for high humidity (85% RH or above) With high humidity, dew must be prevented after painting, from blasting stages up to the film hardening stages. Otherwise, the following may occur: (a) Turning of blasted surfaces (b) Film defects (Blushing, poor adhension) As described above in (1), insufficient ventilation also deteriorates film performance. Consequently it is preferable to ventilate at least three times per hour with with high humidity for two days (this varies according to the type of paint) immediately after painting.
⑭ ⑭	The Safety and Health Standards for Painting	(1) The Safety and Health Standards for Painting The Safety and Health Standards for Painting (March 1979) by Sub-Committee on Ship Painting Rationalization, Product Committee, the Ship builders' Ass of Japan specifies the following: (p. 13, "Others, (4) Gas Detection") (h) When gas concentration reaches 1/3 of the lower explosion limit, stop operations and evacuate workers. (i) When gas concentration exceeds 1/3 of the lower explosion limit, take appropriate measures by adding fans and reducing the number of painting machines, etc.
⑪ ⑫ ⑬ ⑭	Instruments for measuring environmental conditions	(1) Thermometer with hygrometer Asmanm type hygrometer is recommended. This instrument gives correct values by removing radiant heat (error) through ventilation. (2) Surface thermometer Used to measure the painted surface temperature. The instrument generally uses a thermocouple. (3) Anemometer Used to measure the ventilation volume and state.

No.	Item	Explanation
㊺	Erection of scaffoldings	(1) Scaffolding pieces Scaffolding pieces not to be removed are recommended to be of stainless steel. (2) The distance between painted surfaces and scaffolding is to be between 150 and 300 m/m (to Prevent unpainted portions). (3) Scaffold plate distances About 30 m/m (to remove blasted sand and to ensure sufficient ventilation) (4 Height of scaffolding 1,700 to 1,900 m/m (to ensure easy and satisfactory work)
㊼	Illumination	Explosion-proof lamps are to be used for safety during painting and drying.

QUALITY AND INSPECTION NDARD OF DE-RUSTING

THE SHIPBUILDER'S ASSOCIATION OF JAPAN

Note; This is a translation into English from
Japanese by Mitsubishi Heavy Industries, Ltd.

1. Quality and Inspection Standard of De-rusting

(1) Scope

This standard shall be applied to inspection of de-rusting of steel surface before application of shop primer, the first coating and the subsequent coatings.

Note: Shop primer is paint to be applied to steel materials before fabrication to prevent them temporarily from rusting during necessary processing thereof.

(2) Standard grade of de-rusting

(Photographic standards are attached at the end of this book.)

(A) Before application of shop primer

Symbol of the grade of de-rusting	SP-A		SP-B	
Treatment	Shot blast cleaning	Sand blast cleaning	Shot blast cleaning	Pickling
Photographic standard of de-rusting grade	No. 1	No. 2	No. 3	No. 4
Application	Where inorganic zinc paints shall be used or where epoxy resin paints shall be applied to C.O.T., B.W.T. and the external parts.		Where epoxy resin paints shall be applied to parts other than C.O.T., B.W.T. and the external parts, or where the conventional paints including oleoresinous synthetic paints and chlorinated rubber paints, etc. shall be applied.	
Corresponding to S1S	Approximately BSa 2 1/2		Approximately BSa 2	

Note: 1. The external parts mean the outside of shell, the exposed parts of upper deck and superstructure.

2. Respective designations of SIS 05 59 00-1967 corresponding to Photographic standards are described herein.

(3) Before application of subsequent coatings after the first coat

The grade of de-rusting for the damaged parts before application of the subsequent coatings after the first coat shall be treated in accordance with item (B).

2. Quality and Inspection of Surface Cleaning before Painting

Inspection and judgement shall be made in accordance with following practice.

Item \ Paint	Epoxy resin paint	Conventional alkyd resin paints, etc.
Water and salt	Not to be visible to the naked eye.	
Fats and oils	To be removed but the remaining traces may be visible.	
Fume by welding or gas Gutting	Not to be so much as the fume may drop by hand soft touch.	
Chalk marks	To be wiped with dry wastes or thinner but the remaining traces may be visible.	
Marking paints	We will use only the marking paint for epoxy paint, so such paint marks are not to be removed. In other cases to be removed by disc sanding, etc. but the remaining traces may be visible.	Not to be removed.
Other foreign matter	To be cleaned but the remaining traces may be visible.	
Damaged paint film	Damaged or incomplete paint film caused by welding and blistering, etc. not to be visible.	
Welding bead	Slag and spatter to be removed, but small dot (less 0.7 mm dia.) may be remained.	
De-rusting of weld line	May be used with RUST PACK (stripper paste type rust remover)	

Note: At docking, Barnackled, Serpulids, Sea weeds, Fats and oils, and Slime, etc. shall be removed, but the remaining traces may be visible.

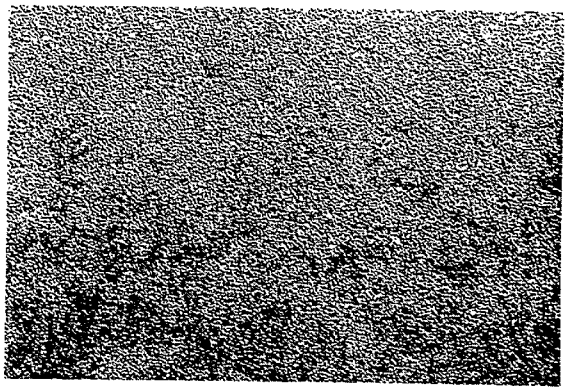
(B) Before application of the first coat

Symbol of the grade of de-rusting		SA	A	B	C
Treatment		Sand blast cleaning	Disc sanding and power brushing	Disc sanding and/or power brushing	Power brushing
Photographic standard of de-rusting grade	De-rusting of the parts of shop primer damaged by burning	No.5	No.6 No.9	No.7 No.10	No.8 No.11
	De-rusting of the parts of shop primer damaged by re-rusting	No.12	No.13	No.14	No.15
	De-rusting of the beads & the near parts of welding	No.16	No.17	No.18	No.19
	De-rusting of the parts of no treatment of miss-coating	No.20	No.21	No.22	No.23
Application			Where epoxy resin paints shall be used to C.O.T., B.W.T. and the external parts.	Where the conventional paints including oleoresinous synthetic paints and chlorinated rubber paints, etc. shall be applied mainly to the external parts, and where epoxy resin paints shall be applied to parts other than C.O.T., B.W.T., and the external parts.	Where the conventional paints including oleoresinous synthetic paints and chlorinated rubber paints, etc. shall be used mainly to the internal parts.
Corresponding to SIS		Approximately BSa 2	Approximately CSt 3, BSt 3	Between CSt 2 & CSt 3 Between BSt 2 & BSt 3	Approximately CSt 2, BSt 2

Note: 1. Photo Nos. 9, 10 and 11 show effect of burning to steel material coated with zinc epoxy primer.

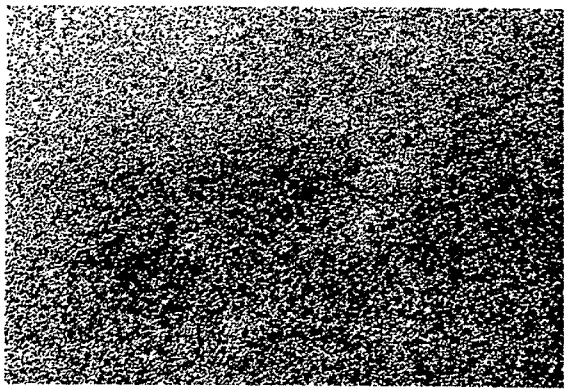
2. The meaning of the external parts is the same as (A) Note 1. The internal part mean all sorts of tanks excluding C.O.T. and B.W.T., engine room Pump rooms tank tops, bilges, holds, inside of living quarters including stores, cofferdam chain lockers and void spaces.

3. As to corresponding designations of S1S, see (A) Note 2.



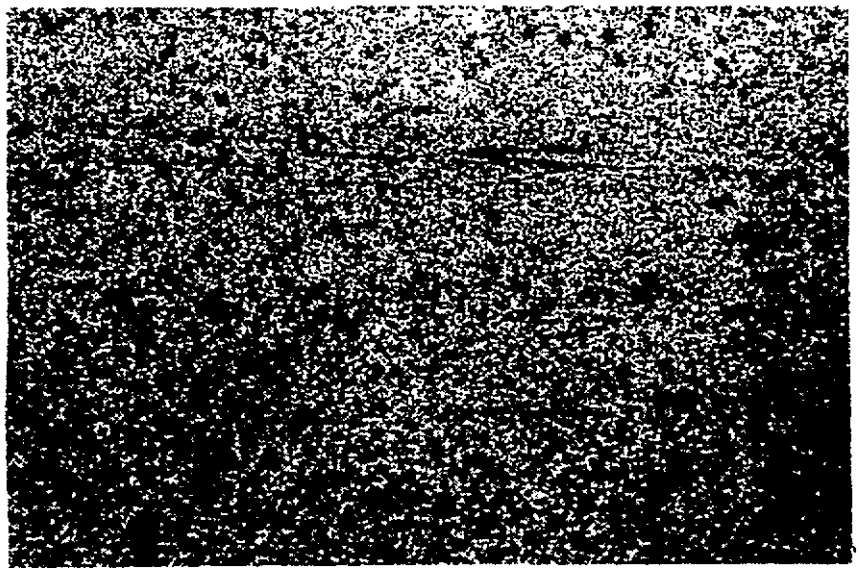
Photographic Standard No. 1
Shot Blast Cleaning.

Mill scale has been removed completely, and the remaining traces, after removal of mill scale, are partly visible in the form of spots or stripes.



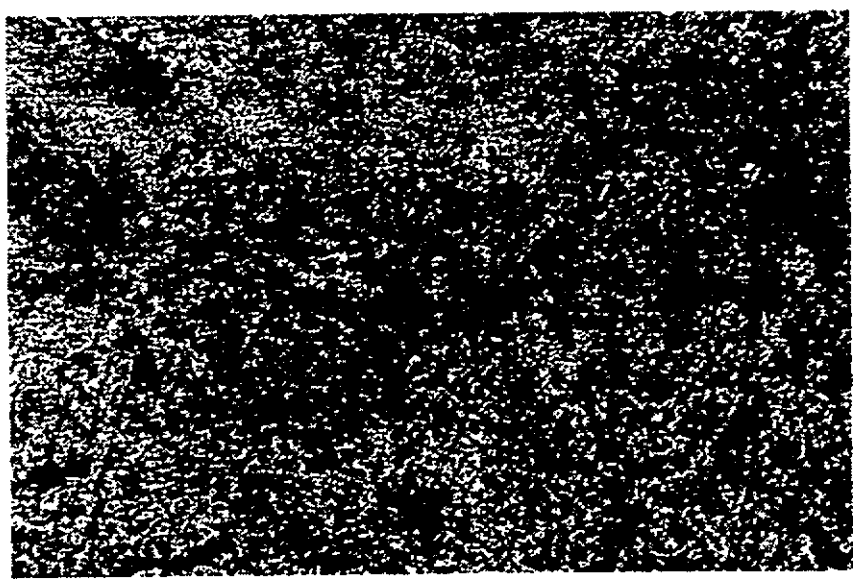
Photographic Standard No. 2
Sand Blast Cleaning.

Mill scale has been removed completely, and slight black abrasives are visible in the little pittings.



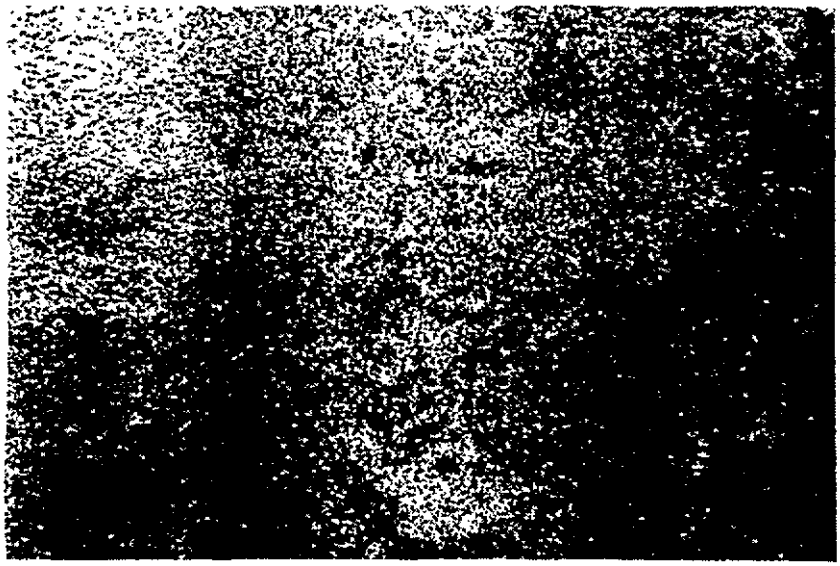
Photographic Standard No. 3
Shot Blast Cleaning.

Mill scale has been removed completely, and little remaining traces after removal of rust are visible.



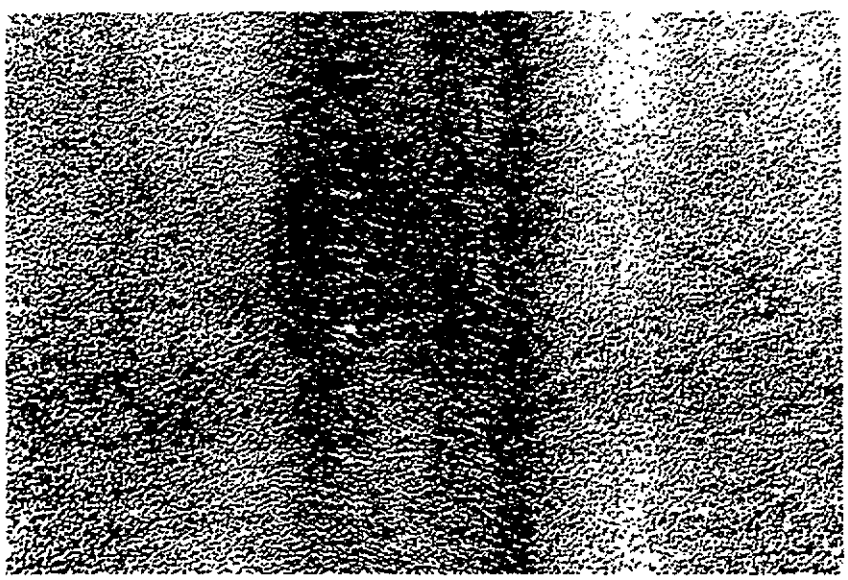
Photographic Standard No. 4
Pickling.

Mill scale has been removed completely, and the remaining traces, after removal of mill scale, are visible in the form of spots or stripes.



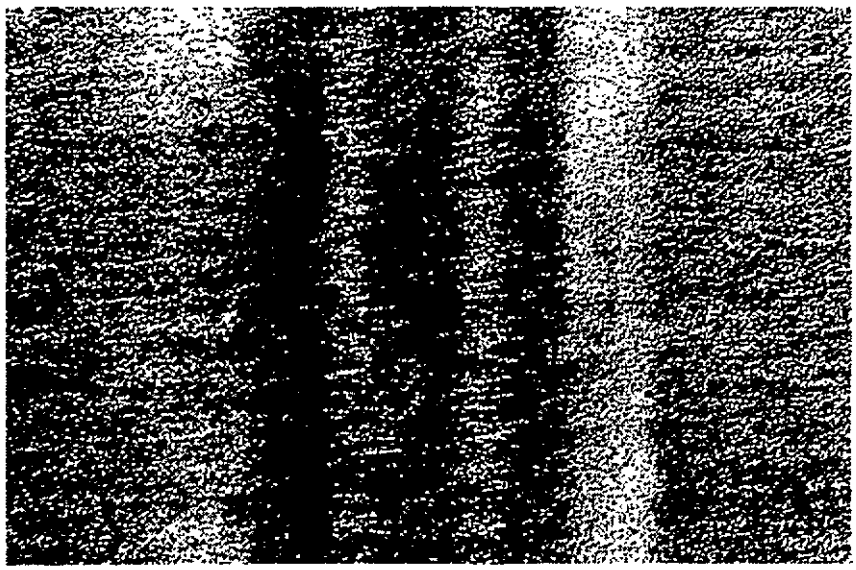
Photographic Standard No. 5
Sand Blast Cleaning to Burnt Areas.

Little remaining traces after removal of rust and slight black abrasives are visible.



Photographic Standard No. 6
Disc Sanding and Power Brushing to Burnt Areas
where Long Exposure Wash Primer has been applied.

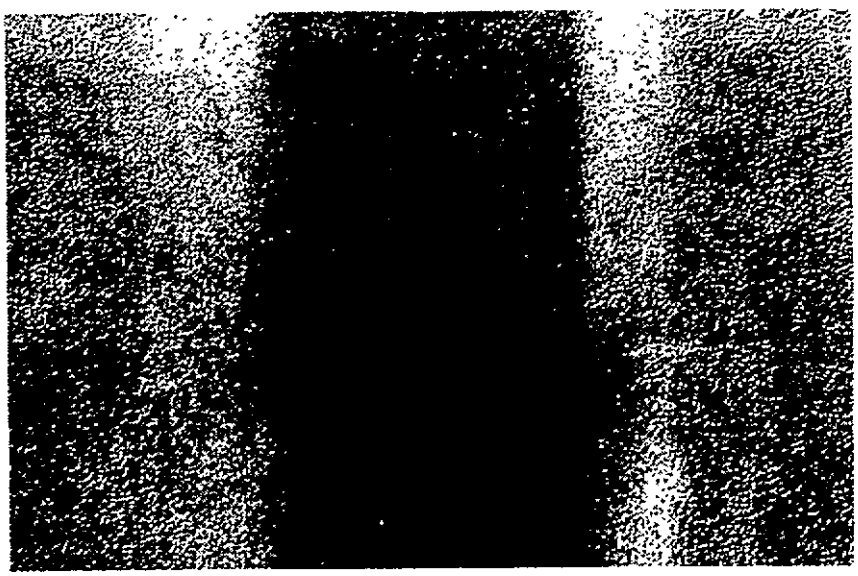
Almost all rust has been removed, and shop primer near the burnt area is changed in colour.



Photographic Standard No. 7
Disc Sanding and/or Power Brushing to Burnt Areas
where Long Exposure Wash Primer has been applied.

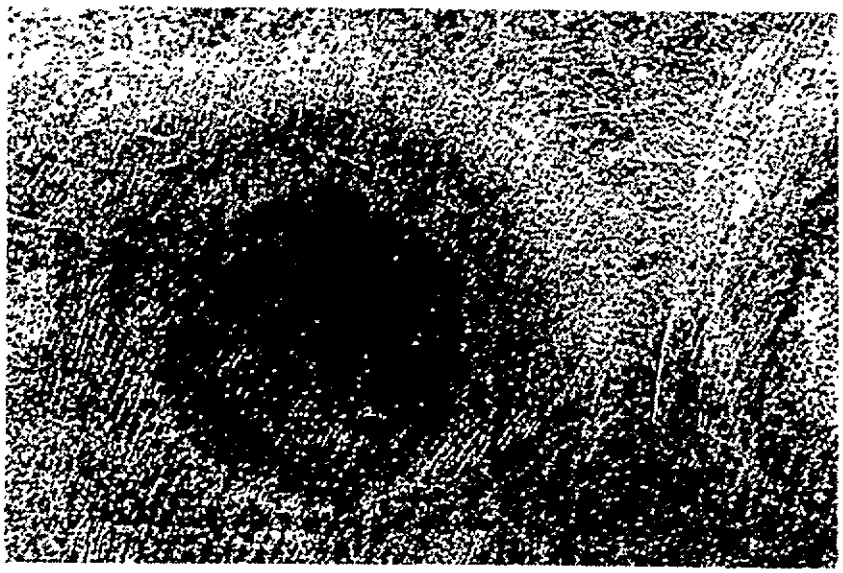
Rust remaining in the pittings is visible, and shop primer near the burnt area is changed in colour.

(This photo shows the condition after disc sanding.)



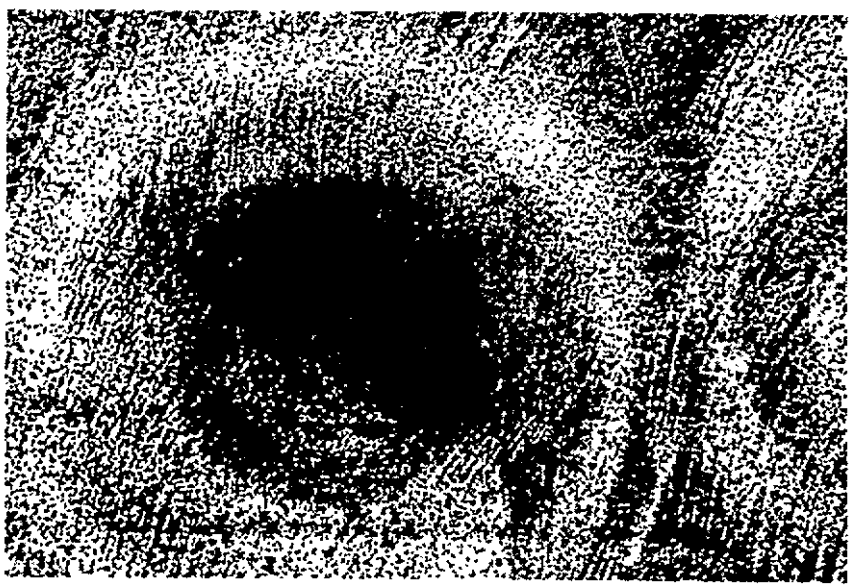
Photographic Standard No. 8
Power Brushing to Burnt Areas where
Long Exposure Wash Primer has been applied.

Loose rust has been removed, and shop primer near the burnt area is changed in colour.



Photographic Standard No. 9
Disc Sanding and Power Brushing to Burnt Areas where
Zinc Epoxy Primer has been applied as Shop Primer.

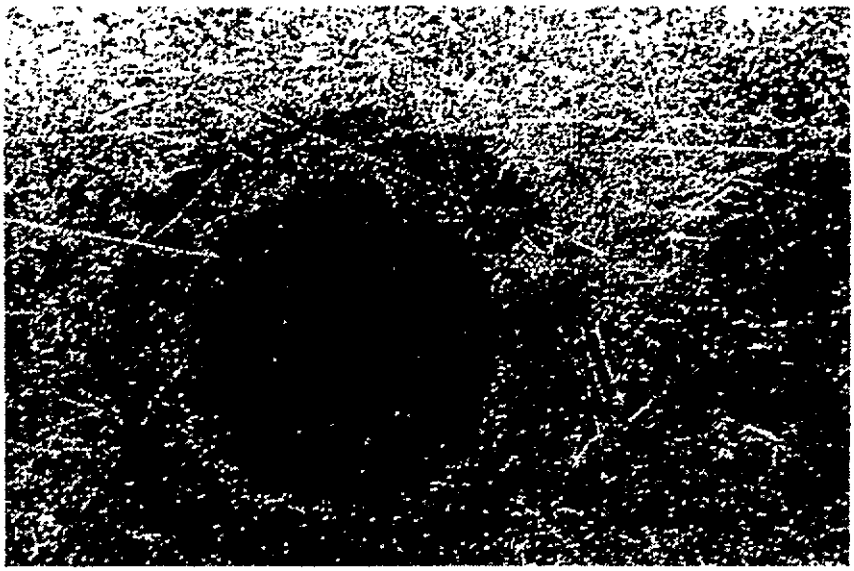
Almost all rust has been removed, and shop primer near the burnt area is changed in colour.



Photographic Standard No. 10
Disc Sanding and/or Power Brushing to Burnt Areas
where Zinc Epoxy Primer has been applied as Shop Primer.

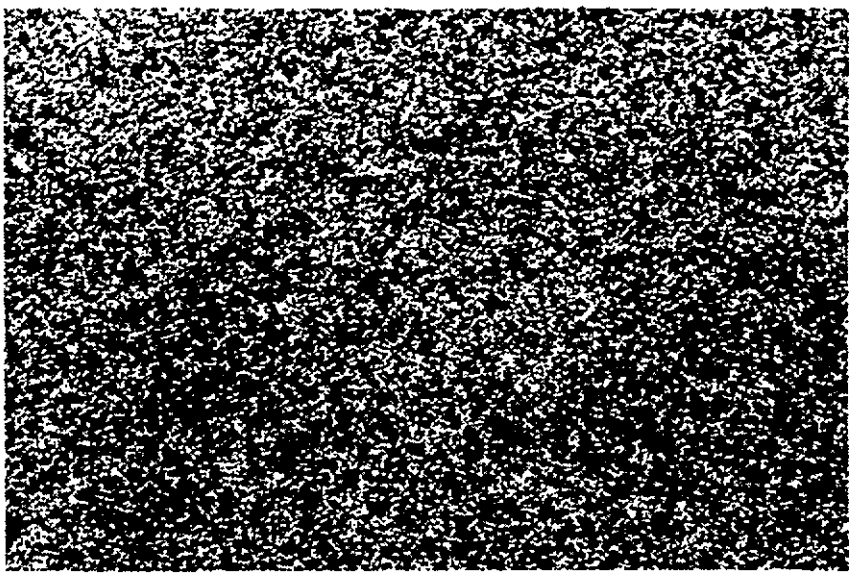
Rust remaining in the pittings and slight heat scale are visible, and shop primer near the burnt area is changed in colour.

(This photo shows the condition after disc sanding.)



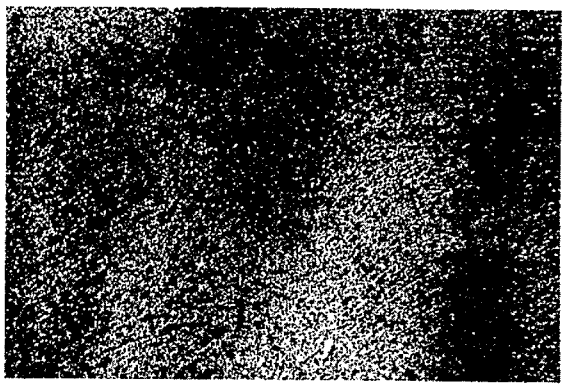
Photographic Standard No. 11
Power Brushing to Burnt Areas where
Zinc Epoxy Primer ,has been applied as Shop Primer.

Loose rust has been removed but heat scale is remaining, and shop primer near the burnt area is changed in colour.



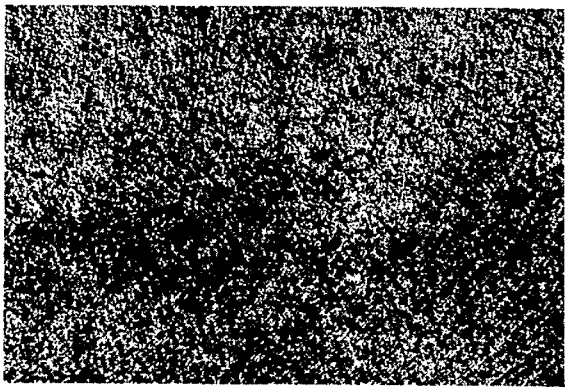
Photographic Standard No. 12
Sand Blast Cleaning to Re-rusted Areas.

Little remaining traces after removal of rust and slight black abrasives are visible.



Photographic Standard No. 13
Disc Sanding and Power Brushing to Re-rusted Areas.

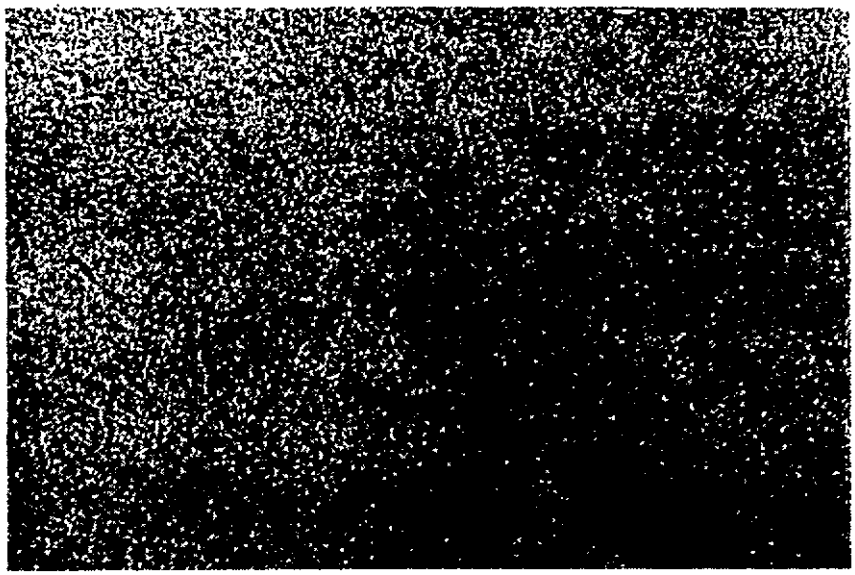
Almost all rust has been removed, but rust remaining in the pittings is visible.



Photographic Standard No. 14
Disc Sanding and/or Power Brushing to re-rusted Areas.

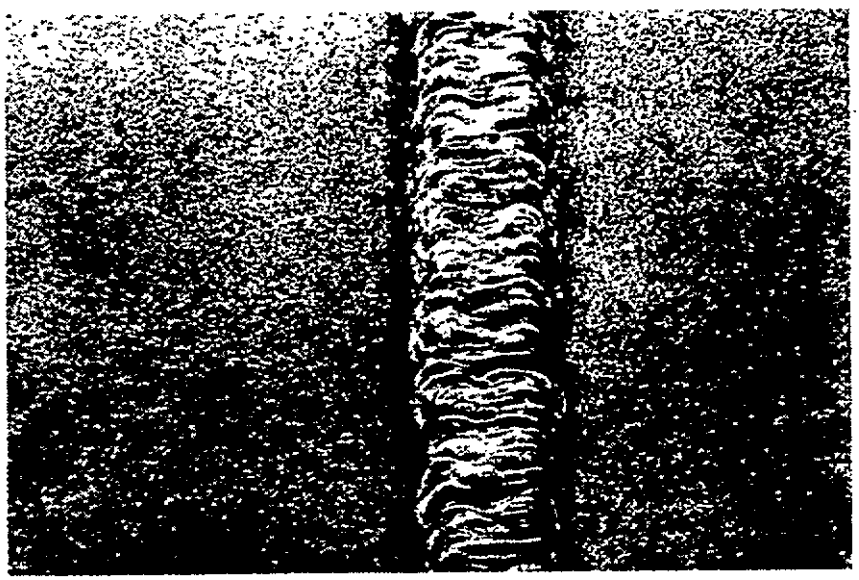
Remaining rust is visible.

(This photo shows the condition after disc sanding.)



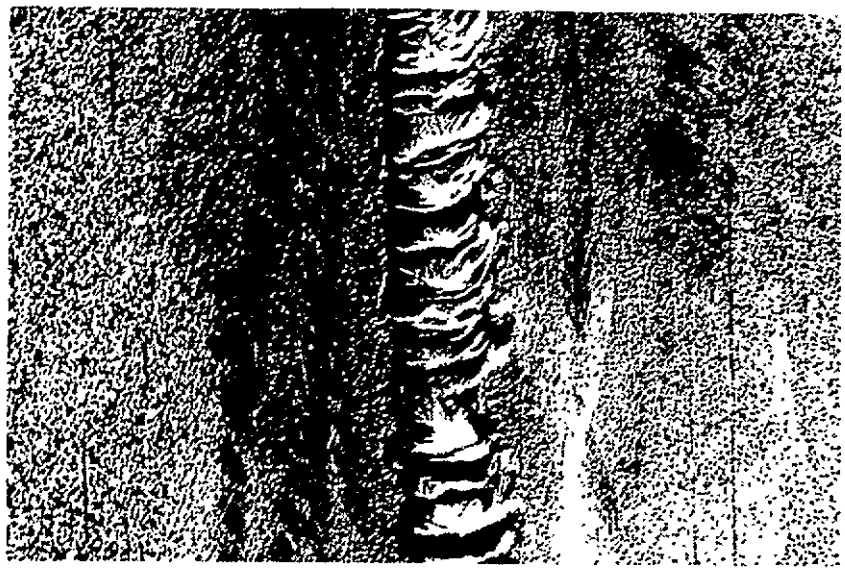
Photographic Standard No. 15
Power Brushing to Re-rusted Areas.

Loose rust has been removed.



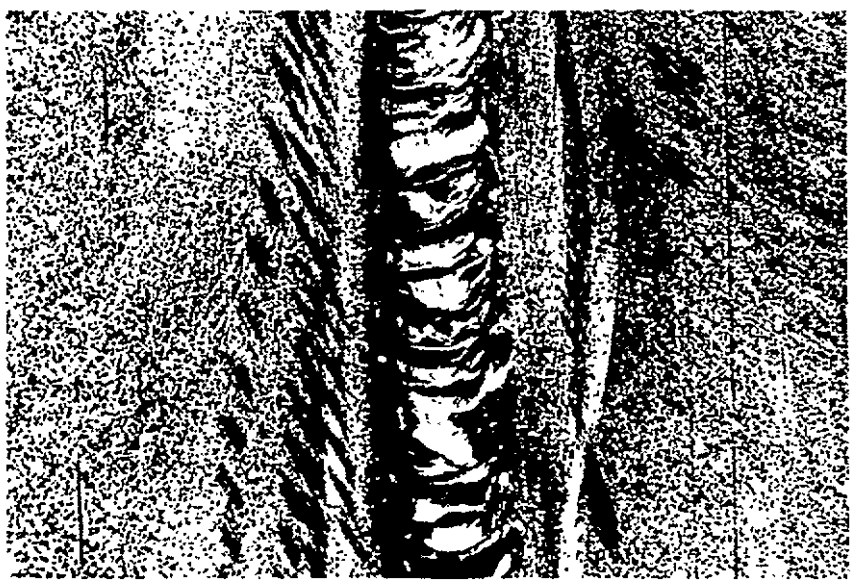
Photographic Standard No. 16
Sand Blast Cleaning to Welded Areas.

Little remaining traces after removal of rust and slight black abrasives are visible.



Photographic Standard No. 17
Disc Sanding and Power Brushing to Welded Areas.

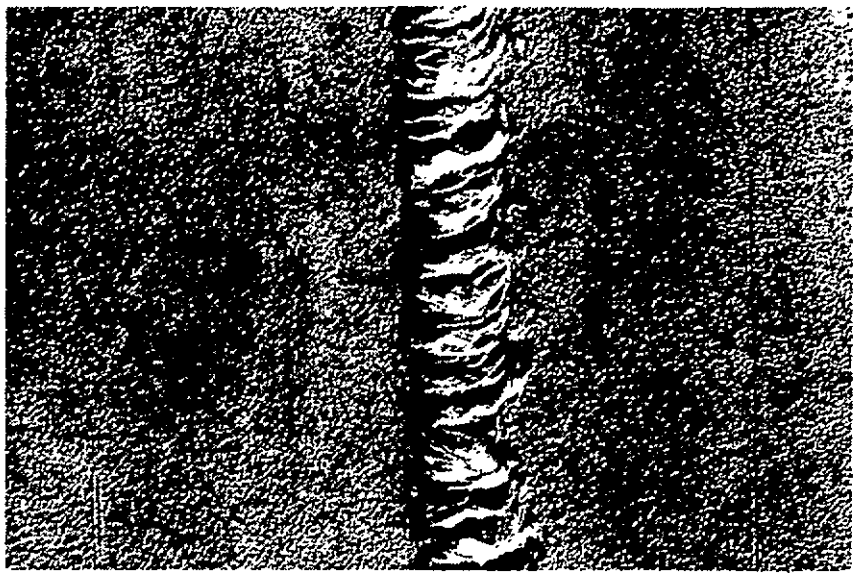
Almost all rust and loose spatters have been removed.



Photographic Standard No. 18
Disc Sanding and/or Power Brushing to Welded Areas.

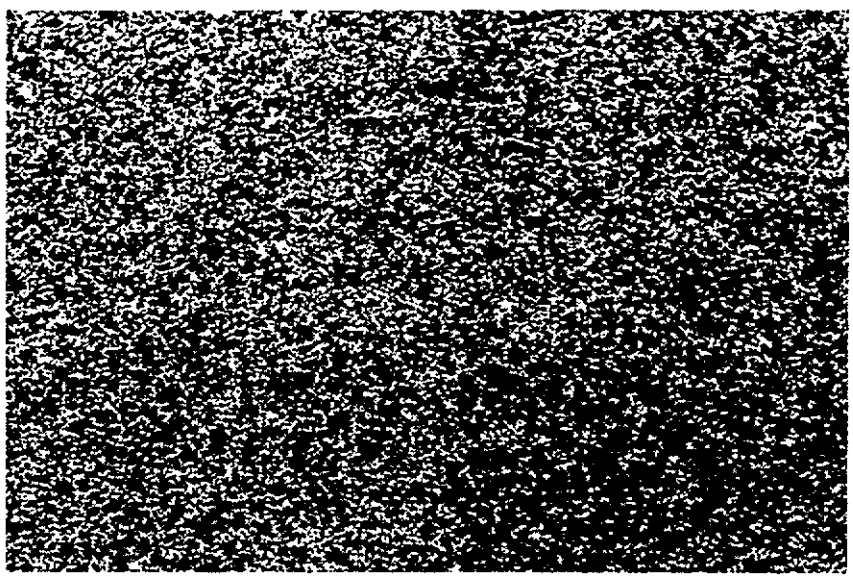
Rust remaining in the pitting is visible, and loose spatters have been removed.

(This photo shows the condition after disc sanding.)



Photographic Standard No. 19
Power Brushing to Welded Areas.

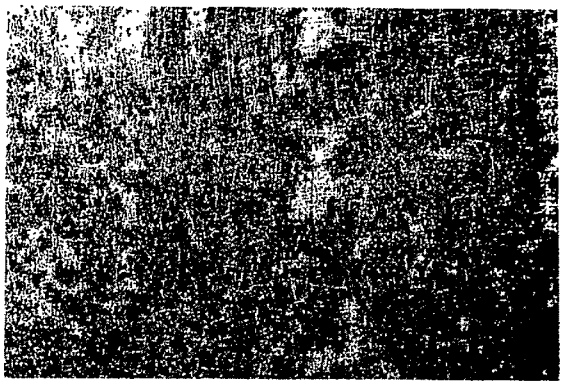
Loose rust and spatters have been removed.



Photographic Standard No. 20
Sand Blast Cleaning to the
Un-prepared or Miss-coated Surface of Steel.

Mill scale has been removed completely, but little remaining traces after removal of rust and slight black abrasives are visible.

(This photo shows the condition after sand blast cleaning to the un-prepared surf ace.)



Photographic Standard No. 21
Disc Sanding and Power Brushing to the
Un-prepared or Miss-coated Surface of Steel.

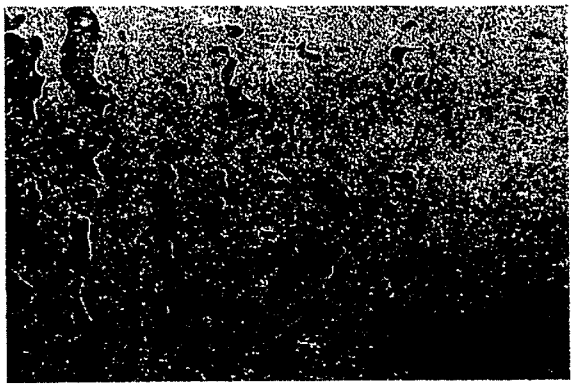
Almost all mill scale has been removed, but rust remaining in the pittings and the remaining traces after removal of mill scale are visible.

(This photo shows the condition after disc sanding and power brushing to the un-prepared surface.)

Photographic Standard No. 22
Disc Sanding and/or Power Brushing
to the Un-prepared or Miss-coated Surface of Steel.

Little remaining mill scale and rust are visible, and the remaining traces after removal of mill scale are visible.

(This photo shows the condition after disc sanding to the un-prepared surface.)



Photographic Standard No. 23
Power Brushing to the Un-prepared
or Miss-coated Surface of Steel.

Loose mill scale and rust have been removed.

(This photo shows the condition after power brushing to the un-prepared surface.)